LOCAL COST-REVENUE ANALYSIS OF PROSPECTIVE INDUSTRIAL FIRMS AND COMMUNITY POLICIES: A WORKING MODEL

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The assumed significance of industrial development is clear, whether or not we look to economic theory, models of urban and regional development or the policies of local, state, and Federal government. The United States Department of Commerce estimated that in 1964 there were 14,000 to 15,000 local organizations promoting economic growth in their respective areas,[1] while the Committee for Economic Development estimated that in 1960 communities and states spent at least $200 million in promoting new industrial growth.[2]

Andrews identified eighteen commonly assumed impacts of industry on a community.[3] At the risk of oversimplification these could be summarized as: (1) new industry in a community creates jobs and an increase in population, (2) new industry produces rising wages in a community, (3) new industry increases wholesale and retail trade, (4) new industry broadens the economic base of a community, providing economic stability, and (4) new industry increases both property and non-property tax revenues, resulting in a net fiscal surplus to the community.

Many economists have questioned the validity of these commonly held maxims and the promotional vigor they generate.[4] More recently, prospects of industrial development have served to highlight the emerging economic growth versus environmental quality conflict. The Governor of Delaware initiated action to abate the location of proposed industries along the Atlantic Coastline of his state. The law will reportedly block the realization of several thousand jobs and $750 million in planned development including a large oil refinery.[5] Similar actions have occurred in communities and states throughout the nation highlighting a reexamination of past policies and assumed impacts of industry.

The impact of new industry on a community, however, is masked by a complex set of direct and indirect effects, immediate and long range impacts, concessions, uncertainties and subsidies. In reference to the last element

> ...it is not clear whether the benefits to be derived by the community from the new firm would exceed the direct costs of the incentives themselves and the indirect public facility expansion costs imposed by the new firm on the community.[6]

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The importance of developing a model to analyze local cost-revenue impacts of an industrial plant can be justified on two grounds. First, the impacts of an industrial plant on a community are very large. Numerous residential location decisions are required to equal the impact of one large industrial firm, particularly if secondary impacts are considered. The second factor stems from the relative uniqueness of the cost-revenue impacts of industrial location decisions. Not only is it true that relatively few industrial location decisions are made over time, but unlike the case with residential decisions, the local cost revenue impact of industrial location decisions can vary substantially depending upon the size of the firm, the products produced, the production processes employed and the nature of the labor market.

The purpose of this paper is to develop and apply a cost-revenue model exposing the direct and secondary fiscal impact of a prospective industrial firm on a local community. The model is designed to assist local decision makers prior to and in conjunction with preliminary bargaining sessions during which the community may be asked to provide concessions in the form of utility extensions, zoning changes, or special concessions (tax abatements, etc.). As such, the model evaluates only one of several possible community objectives in soliciting new industry. Yet, this cost-revenue criteria is often crucial to the local community and in some cases the nature of the concessions may be a critical factor in the firm's location decision.[7]

PREVIOUS STUDIES

Several previous studies have attempted to gauge the cost-revenue implications of industry on a community. In a study conducted in 1957, Walter Isard noted, "The municipal revenues generated by a new industry are frequently considerably greater than the additional costs."[8] Other studies have found that industry produces a ratio of revenues to costs of three to one in Greenwich, Connecticut, and Evanston, Illinois, five to one in Arlington, Virginia, and four to one in Yorktown, New York.[9] A study analyzing the impact of industrial development on local school expenditures found that production oriented industries produce a net fiscal surplus of $615 per employee annually, while research oriented firms produced a surplus of $1,590 per year.[10]

In a comparative study including the cost-revenue impact of industry on six small Wisconsin cities, Richard B. Andrews noted, "On the major criteria of population growth, employment opportunities, trade and income, lower taxes, and general morale, the more industrialized cities are generally found to have an advantage over the less industrialized."[11]

Norton Dodge and John H. Cumberland have studied the cost-revenue implications of a proposed oil refinery and free trade zone in a rural tidewater Maryland area. They isolated and included environmental externalities in their analysis and found that the environmental costs imposed "... revealed the existence of probable indirect effects and costs which would negate or exceed the benefits expected from construction of the petroleum industry."[12]

CRITERIA FOR A LOCAL FISCAL IMPACT MODEL

The studies reported above indicate that variation in the local fiscal surplus or deficit generated by industrial firms exists between communities and types of plants. Variations in these impacts have also been identified between different locations within a community.[13] These studies do highlight the previously articulated need for a comprehensive model to isolate the impacts of a new plant on a community.

In light of these studies the need for a new model may not be clear, however. Criteria for a model analyzing the cost-revenue impacts of a potential firm on the community can be established and the ability of existing models to meet these criteria can then be evaluated.

The criteria established are:

1. The model should be geared to an a priori analysis so as to aid in pre-location policy formulation.

2. The model should be comprehensive so as to evaluate all significant direct and secondary, immediate and long range impacts of a plant.

3. The model should be flexible so as to illustrate the sensitivity of a project to concessions, different local policies and different assumptions.

4. The model should be adaptable so as its use will not be restricted to a particular community or plant.

None of the models studied meets all of these criteria. The most common incompatibility stems from the use of ex post facto analysis. The Dodge-Cumberland analysis is a priori but not comprehensive. In decisions about the efficacy of a specific policy or concession regarding proposed development, the models previously employed do not provide the proper information in a usable and flexible way. A new model is called for.

THE MODEL

The model formulated to meet the above criteria is actually a linked series of submodels providing input into the present value model commonly used to evaluate public and private investment decisions.[14]

As is the case with many research techniques a tradeoff exists between the immediate feasibility of a particular technique and the important requirment of scientific validity. While researchers strive for both, limited data sources or overt complexity often preclude mutual attainment. The practitioner is left with models which are either too complex or expensive to use or too simple to provide usable, valid information. Hopefully, a reasonable compromise has been struck in the development of this model. At any rate, this model embodies the philosophy behind Bauer's observation that, "Rather than do nothing it is preferable to start out with bad data, warn everyone about the defects and limitations, and aim at gradual improvement through use."[15]

The uncertainties in a priori analysis such as this model attempts to undertake are many. One approach to deal with the uncertainties is to use sophisticated techniques of analysis including input-output analysis and simulation methods. Another approach is to design the model so that iterative solutions can easily be undertaken based on different assumptions. In the former approach we do not have sufficiently comprehensive models to account for all of the uncertainties. Additionally, such sophisticated techniques may restrict the analysis to those communities with the resources necessary to implement the techniques. This model advocates the latter approach stressing an iterative process. The model is designed so that the researcher can input different assumptions, observe the sensitivity of the project to these assumptions and reflect on the range of outcomes. Communities with more sophisticated tools and resources such as input-output tables and regional multipliers can substitute those into the model, while those lacking the resources are not precluded from use.

The relationship of the submodels is portrayed in the following text and in Figure 1.

Study of Plant Characteristics. The first step in the model is to reveal the initial and planned plant characteristics having potential fiscal impacts. This step seeks to identify characteristics such as the number and skill levels of employees, the value of the initial investment, average hourly and yearly wages and potential demand for community services. Possible data sources include consultation with the firm's management and architects, new releases, and published statistics such as the United States Census of Manufacturers released by the U.S. Bureau of the Census every five years.

Study of Existing Community Resources. The next step of the model calls for the researcher to evaluate the community's ability to meet the needs of the prospective plant as revealed in Step 1. The community's housing supply, labor supply, educational and other public facilities should be all assessed. Relevant environmental assets of the community should also be detailed.

Synthesis. In the third step of the analysis the results of the surveys of plant requirements and community resources are synthesized into a statement of incremental impact of the plant upon the community. For example, Step 1 might have revealed that the plant expected the community to provide on-site sewer and water facilities while Step 2 indicated that such facilities did not presently exist nor were they presently planned. Step 3 would indicate that these facilities would have to be provided and cost estimates prepared in subsequent steps of the analysis. Step 3 does not attempt to assign costs or benefits to impacts, but rather to broadly catalogue the dimensions of the plant's cost-revenue impact.

Employment and Population Impact Model. The next step in the model is to develop one or several feasible employment and population distributions reflecting both direct and secondary effects of the plant. The indirect effects are those resulting from the increase in a community's base employment which can generate increases in local economic activity including new service employees, additional income, etc.

The direct employment effect generated by the firm should first be adjusted to reflect the local employment multiplier, yielding a total employment impact figure. These multipliers are specific to locales and may be unknown in some communities. Estimation of the employment, population, and income multipliers may be hazardous since significant variation does exist in their values for different communities. Charles Tiebout has found the value of these multipliers to be quite low in small locales,[16] and Hirsch notes that these multipliers effects may be omitted when dealing with small regions.[17] In large communities where these multipliers might be significant but remain unknown, the researcher might attempt to determine the multiplier from the existing base to service employment ratio or to identify those multipliers derived in similar size cities with a comparable economy to that of the study area.

The total employment impact must then be distributed among the possible sources of employment detailed in Figure 2. These distributions should at least allocate the total employment impact into the Inmigrant and Not Inmigrant groups and preferably the two subcategories of each of these as shown in Figure 2. Inmigrants will have the largest fiscal impact on the community, but in certain situations commuters may significantly affect costs and revenues. The employment filtering effect, initiated when new employment opportunities induce workers to leave existing positions with firms in the community should be considered. The jobs so vacated may be filled by any of the subgroups in Figure 2 including inmigrants. This "employment vacancy chain" is ended by an inmigrant worker, a new worker (recent school graduate or housewife), a previously unemployed worker, or the employer's decision to not fill the vacancy. This iterative process is represented by the dashed line in Figure 2.

In allocating the total employment impact to these groups the researcher should observe area unemployment rates, skill levels of the labor force, and the prevailing area and industry wage levels. This step obviously requires refinement, but sufficiently refined models do not exist at this time to aid in the distribution analysis of prospective employees. Lacking these models, the researcher should compute at least two distributions of total employment among the groups in Figure 2 so that sensitivity of the investment to these assumptions can be observed in subsequent phases of the anaysis.

If the population multiplier is known the researcher can apply this multiplier to the initial base employment generated by the firm yielding a total population impact figure. If, however, this multiplier is unknown the researcher can multiply the total employment impact figure by the population/worker ratio, prevailing in the community. In a similar manner school enrollment changes can be estimated by applying the appropriate enrollment/worker ratios to the total employment change.

Changes in dwelling unit construction associated with the assumed employment impacts are difficult to estimate with accuracy but can be computed by observing existing vacancy rates, plant wages characteristics and housing market supply characteristics.

Even more difficult to estimate are the income effects which assume cost-revenue implications if local sales or income taxes are assessed or if state disbursements to local governments are proportional to the amount of revenue collected in the local government.

The income impact is composed of the income of residents directly employed by the firm plus the income of new service employees generated by the firm. The former figure can be otainted by applying aggregate average yearly figures existing in the industry in the locale (if a sufficient number of firms exist) or in the state and applying a suitable inflator or deflator. The latter figure can be otained by computing a weighted service sector average annual wage and applying this to the service sector employment generated.

The results of this analysis are then placed in tabular form similar to that of Figure 3.

The figures in this table should not be expressed in terms of dollar impacts on the fiscal balance. Rather, these figures constitute the raw data from which the fiscal estimates are made. Other impacts should also be tabulated including the number and estimated value of new residential construction generated by the firm within the community.

Annual Cost and Revenue Model. The purpose of this step of the analysis is to assign annual costs and revenues to the data collected in preceeding steps. Annual costs and revenues, as contrasted with capital expenditures, in that the former occur periodically over time, usually yearly. This phase of the analysis requires a careful survey of local expenditure and revenue budgets as its primary data input other than figures previously derived. The equations expressed here are intended for illustrative purposes only. Specific variables to be included in the equations should be determined by the researcher.

If the researcher has properly executed Steps 1, 2, and 3 the tabulated of annual revenues generated by the firm should not present major difficulties.

The analysis of annual revenue impacts is best achieved through the use of an equation such as:

$$E_t = a(Q)_t + b\ (y_1 + y_3)_t + c\ (z_1 y_1 + z_2 y_2 + z_3 y_3 + z_4 y_4)_t \ldots \text{etc.}$$

Where:

E_t = annual revenues in year t;

a = the local property tax rate adjusted to full valuation;;

Q = value of the firm, and induced residential and commerical investments;

b = local income tax rate adjusted to reflect deductions, etc.

y_1, y_3 are defined in Figure 3;

c = the local sales tax rate;

$z_1 \ldots z_4$ = an estimate of the proportion of income subject to the local sales tax of the respective "y" groups

$y_1 \ldots y_4$ are defined in Figure 3.

This model should be extended to reflect all anticipated revenues generated by the plant including any special charges levied against the firm.

The estimation of annual costs is a more difficult proposition. Hirsch recommends that these costs be keyed only to population changes generated by the firm.[18] While the simplicity of this approach is attractive, it masks the costs of specific concessions offered to the firm, and does not separate capital from non-capital expenditures. Yet, a complete breakdown of costs is overly tedious and may not be accurate in aggregation. This model advocates a compromise between these two approaches by breaking costs down into capital and non-capital, and those directly related to the firm as opposed to indirect effects. An illustrative equation might take the form (capital costs are treated in Step 6.)

$$M_t = d(s_1)_t + e(p_1)_t + f_i\ (X_i)_t \ldots$$

M_t = annual costs for year t

d = per capita school expenses excluding retirement of capital bonds;

s_1 is defined in Figure 3

e = ratio of non-school personnel expenditures/population

p_1 is defined in Figure 3

f_i = per unit cost of providing service i to the firm and other users generated by its location

x_i = units of service i utilized as a result of firm's decision

In the application of this equation the possibility of double counting costs is present, as is the possibility of mixing capital and non-capital costs. For example, in the equation above, public personnel costs are viewed as a proxy for variable costs associated with population increases. Additionally, the costs of providing major services to the firm are also tallied (X_i) and some of these might be accounted for through personnel costs. Only a careful review of specific entries in specific situation can reduce double counting.

Capital Costs. The next step in the analysis calls for the researcher to estimate the value of public capital investments generated by the firm. The primary data source employed is the comparison of the needs of the firm to the resources of the community. The focus is on public costs required only once in the course of a project. A distinction should be made between direct capital costs associated with the plant and secondary effects the plant's location generates, so that the impact of different investment strategies can be evaluated.

In some cases these costs will be apparent; such as the need for a major sewer line or road to service the plant. In other cases the costs may be less apparent such as the need for new classroom space. The judgment of the researcher is required combined with the computation of sensitivity effects.

Present Value Model. The final step in the model is to combine capital costs, and yearly revenue and cost figures in a meaningful way. For this purpose a present value formulation is used. This model compares initial outlays to a discounted steam of future revenues and costs. Through discount rates all future revenues and costs are transformed into dollars of present worth reflecting the time value of money, permitting the comparison of future impacts to immediate outlays. The model commonly employed is:

$$PV = \sum_{t=1}^{T} \frac{E_t - M_t}{(1+r)^t} - K$$

Where:

PV = net present value of project

T = the number of years the project is evaluated for;

E_t, M_t are as previously defined

r = the discount rate

t = time

K = initial capital investments.

The discount rate used in the analysis is crucial to the model and the selection of a proper discount rate has been the subject of debate among economists. Hammon notes that industrial land developers often consider .2 as the appropriate rate.[19] However, public enterprise has other objectives beyond profit and such a high discount rate might preclude many public investments worthy of consideration. Haveman states that, "Most economists now agree that the interest rate which should be used in public sector investment... implies that a discount rate of 8 to 10 percent should be applied in evaluating public projects".[20] Rather than choose a specific discount rate the researcher may ferret out the discount rate which causes the present value of annual revenues and costs to just equal the capital outlays, the implication being that at higher discount rates a project shows a negative present value, while at lower discount rates it shows a positive present value.

Aside from the discount rate the researcher must select an appropriate time period over which to evaluate the project. A time period of twenty years is usually adequate since the present value of a dollar received twenty years hence at a discount rate of .10 is but $0.15. The careful researcher will evaluate the project for periods of 10, 15, and 20 years to observe sensitivity effects.

The output of this present value formulation, whether expressed in terms of the net present value of the project or in terms of the internal rate of return, has great merit. It summarizes in one number a myriad of local conditions and policies as well as assumptions of the researcher in collecting the data and formulating the equations. It permits us the combination of capital costs, and yearly cost and revenue estimates into a statement of the net present cost-revenue attractiveness of the project.

The model framework described above proceeds from an initial statement of the needs of the plant to a specific calculation of the cost-revenue impacts. Several major difficulties in the estimation of the model parameters could dilute the utility of the approach. While regional employment, income and population multipliers would relieve the researcher of uncertainties associated with gross impacts, they are of little help in distributing that impact among the various subcategories shown in Figure 2 and 3. Other major difficulties in using the model concern the difficulty of separating, but not double counting, the direct and secondary annual and capital costs.

The model presented here is not specifically calibrated, but given the uniqueness of industrial cost-revenue impacts across both industries and communities and the inherent uncertainties of a priori analysis, such a calibration subsequently applied to all communities appears unrealistic. The model can be calibrated on the local level, however, and once the relationship between the direct employment and total employment, population, school impacts and their associated costs is established the researcher can vary his assumptions about the employment distributions, and community policies and observe the differential cost revenue impacts. In some cases the investment might be consistently wise or unsound despite wide variations in the assumptions. If on the otherhand, the efficacy of the project varies with certain assumptions the researcher should be in a position to estimate the most probable assumption and policy set and evaluate the impact on that basis.

APPLICATION OF THE MODEL

The model described above was applied in a real world situation involving the prospective location of a textile dyeing and finishing plant in an unincorporated area of Orange County, North Carolina just beyond the corporate limits of Hillsborough. During a preliminary bargaining session one of the County Commissioners remarked, "The allocation of this much of the county's resources to employ maybe 75 people and put maybe $1.5 million on the tax books is not warranted." The application of the model is reported in brief form, but does illustrate the type of problems the technique can deal with.

Analysis of Plant Characteristics. Initially the plant was to involve capital expenditures of $1.67 million, employ 75 low skilled workers, and require 250,000 gallons of water per day discharging an equal amount of "mild" effluent.[21] Within three years the firm planned to expand investments to $2.67 million, employment to 100, and water usage to 500,000 gallons daily. Wages paid by the industry (Standard Industrial Classification 226) were roughly comparable to the prevailing manufacturing wages in the area. The proposed location was serviced by roads, but not by sewer and water lines.

The major policy requests of the firm were that the county provide sewer and water extensions and that the community guarantee an adequate supply of water.

Analysis of Community and County Resources. Hillsborough is a small community with a 1970 population of 1400, reflecting a modest increase during the previous decade. Community leaders are quick to mention a lack of new investment in the community and the town faces the fiscal dilemma of a declining tax base and increasing demands for public services. Major revenue sources include local property tax revenues and transfer payments from State and Federal government. The town operates the water system and distributes an average of 350,000 gallons of water per day while treating 100,000 gallons (septic tanks account for the difference). Unemployment rates in the community are very low and many residents commute to an adjoining county for work opportunities. The town business and political leaders supported the location of the firm believing that revenues from sale of water to the plant would enhance community fiscal resources and increase retail trade. The town is located at the headwaters of the Eno River, a source of water for downstream communities.

The county presents some interesting contrasts to the above. Its population grew by 35 percent to 57,000 during the 1960 and 1970 decade. This growth in both population and associated new investment has been closely linked to growth of a major university located within its boundaries, providing the county with a growing, if highly concentrated, economic base.

Unemployment rates in the county have been consistently below the national figures. The County did not presently operate a water system. County revenue sources include property taxes, and a 1 percent sales tax levy as well as government transfer payments. The county commissioners were split in terms of support for the firm.

Synthesis. After completing Steps 1 and 2 above, some of the specifics of the plant's location became obvious. The firm requested that sewer and water facilities be extended to the site. Since such facilities did not presently exist and since the proposed location was in Orange County, the county would be expected to extend those utilities. In return, the county would receive revenues from the ad valorum taxes assessed against the plant and new dwelling units, and revenues generated by increases in the county's sales tax revenues resulting from increased retail trade.

Since the county did not presently operate a water system the town was asked to guarantee a sufficient supply of water, and to treat the plant's effluent. Because the town was at the headwaters of the Eno River, the guaranteed safe yield of the Eno would have to be increased to insure sufficient supply. Current water and sewage treatment facilities were inadequate to cope with the incremental demand and would have to be augmented at the expense of both the county and the town. The primary revenues generated by the firm's location and accruing to the community would be from the sale of water to the plant.

It was assumed that the wages paid by the firm would be identical to those paid by the textile dyeing and finishing industry in North Carolina. Given this assumption, the wages paid by the prospective plant would be slightly higher than the prevailing industrial wages in the County.

The plant's manufacturing process relied almost exclusively upon low skilled male labor. In September of 1971 the supply of available experienced male labor in Orange County was 50, indicating that Orange County unemployed labor could not be a major labor source for the plants. In nearby Durham County, however, the supply of available males was 365 and these people would have a short journey to work if they accepted employment at the plant.

Employment and Population Impact Distributions. Two population and employment distributions were developed based on background data derived from Steps 1 and 2. One assumes that inmigrants into both the county and the town will be relatively few and that most of the employees will commute from a major population center in an adjoining county with the above mentioned reserve of experienced labor. The second distribution allows for more inmigrants into both the county and town thus accentuating the cost-revenue impacts keyed to population.

Since the community and county are both small and a major trade center exists in a nearby county within easy traveling distance, substantial income leakage would occur and induced effects would be minor. Additionally, the existing economies of both the town and the adjoining area of Orange County were not conductive to significant economic integration with the proposed plant. Hence, as per Hirsch's suggestion (footnote 17), the secondary impacts were assumed to be insignificant.

Derivation of Annual Costs and Revenues. Based upon a review of town and county expenditures and revenue sources, models were developed to translate the employment and population impacts into cost-revenue figures. Some of the variables considered in the town model were: property taxes derived from new dwelling units constructed by inmigrants, revenues from the sale of water to the plant, proxies for variable costs associated with population growth, and variable costs associated with providing the water the plant would require. County tabulations included property tax revenues, proxies, for variable costs and revenues, and per capita school expenditures.

Separate calculations were then performed for the county and the town which converted impacts into monetary terms. The results, expressed in terms of annual revenues and costs, are shown in Table 1. The figures are separated into two time groups reflecting the planned plant expansion.

Derivation of Capita Costs. The capital cost input to the model included those costs generated by the plant's needs. Hence, for the county these included the $67, 000 required for the utility extension, and an additional $31, 250 representing the county's share of the expansion of water impoundments in keeping with the plant's requirements. The town's assumed capital costs totaled $221, 400, all of which were associated with the need to expand the local water delivery systems, and all of which assumed local share of the costs would remain similar to present formulations.

Present Value Formulation. The results of the analysis are summarized in Tables 2-5. Two separate sets of calculations were performed, one each for Hillsborough and Orange County. In each set of calculations sensitivity effects were computer for the discount rate (via determination of the internal rate of return), the number of years the analysis extended, the two employment and population impacts, and one assumed policy change for each of the areas.

Orange County's underwriting of the total cost of the sewer extension appears questionable. Under population distribution one, which assumes low inmigration of new residents into the county, the project shows a positive net present value at a 9 percent discount rate only if the benefits continue for twenty years (Table 2). Under the assumption of higher inmigration included in distribution two, the underwriting of the total extension costs by the county shows a negative net present value at a 9 percent discount rate for all time periods. Given the negative bias of these outcomes it is unlikely that the county could pay all of the extension costs and still be able to justify the investment on a cost-revenue basis.

We might now ask, is the project justifiable if the county and plant equally share the costs of the extension? As seen in Tables 2 and 3, the project is more desirable under the reduced capital assumption and shows a positive net present value in all but two cases. Given the low unemployment rates prevailing in the county, the higher inmigration and lower net benefits assumed in the latter two cases are a distinct possibility. The county commissioners would have to accept the very real possibility that even if the initial costs of the utility extension were shared equally with the plant, the revenues might not equal costs in the long term.

The results of the analysis clearly indicated that the project does not produce a desirable cost-revenue balance to the town of Hillsborough. Unlike the case with Orange County, the population distribution sensitivity effects are minor and only the more favorable effects (Distribution 1) are reported here. Given this slightly more favorable distribution one, the revenues generated by the location of the plant are insufficient to offset the costs so incurred (Tables 4, 5).

Since the plant site is close to the existing corporate border of Hillsborough, it appeared that extension of the corporate limits to include the proposed plant and receive property tax revenues was a definite possibility. Tables 4 and 5 indicate that even if the area was already within the corporate limits and even if the town assumed no additional costs through incorporation, the investment remains undersirable. At best, the internal rate of return is .05, an insufficient rate to produce a positive net present value at a 9 percent discount rate.

SUMMARY AND DISCUSSION

This paper has developed and reported on some preliminary findings of a model designed to determine a priori the cost-revenue impacts of a prospective industrial firm on a community. Recognizing the uncertainties associated with this type of an analysis the technique does not aim to a single numerical solution, but rather stresses an iterative approach seeking to expose the effects of a researcher's assumptions and possible community policies. While not an optimum approach, it allows for improvements when better submodels are available.

Can the model perform its functions? Given the application reported in this paper, the answer would appear to be "yes." It can reduce the multitude of impacts to a meaningful symbol. It can tell the researcher how critical his assumptions are. It can transform public policies into cost-revenue implications and serve as a policy analysis tool. It can, however, lead to incorrect conclusions as well.

It is not sufficient to know if a model does what it is designed to do. We must also evaluate how well it performs its task.

In its present form the model has too many relationships which the researcher may have to develop on less than a sound empirical basis. This is particularly true in developing the equations which determine the annual costs and revenues. Additionally, the model requires the separation of annual from capital expenditures and direct from secondary costs and revenues. While conceptually simple, these distinctions are difficult to unravel in practice. In short, while the structure of the model appears valid, reconsideration of the form of the equations may be necessary.

Another problem with the model is the difficulty of anticipating and distributing total population and employment impacts among the sub-groups in Figure 2. Observation of the impacts of recently located plants may be helpful, but the variations across time, industries and plants are likely to be large.

In its currect form the analysis suggested here is as much an art as a science. In the hands of a careful researcher willing to seek out the sensitivity effects of his assumptions, and willing to make those assumptions clear, the technique does have some validity. Hopefully, through use and basic research investigating labor maket dynamics, actual incurred costs, etc., its utility will increase.

TABLE I

ANNUAL REVENUES, COSTS AND CAPITAL COSTS (IN THOUSANDS) OF DOLLARS) FOR TWO POPULATION DISTRIBUTIONS

	Years 2 and 3				
	E	M	E	M	K
Orange County					
Distribution 1	19.5	10.4	29.9	15.8	98.2
Distribution 2	22.9	18.5	34.3	24.3	98.2
Hillsborough					
Distribution 1	32.7	30.2	63.8	60.5	221.4
Distribution 2	35.5	31.2	66.7	61.5	221.4
Distribution 1 (assuming incorporation of plant area)	43.8	30.2	81.6	60.5	221.4

E = Annual Revenues
M = Costs
K = Capital Costs

TABLE 2

NET PRESENT VALUE ($000) OF BENEFITS TO ORANGE COUNTY AT .09 DISCOUNT RATE

	Years Evaluated		
	10	15	20
Employment, Population Distribution 1			
full capital	-28.7	- 5.5	9.5
reduced capital[a]	4.8	27.9	43.0
Employment, Population Distribution 2			
full capital	-52.2	-35.8	-25.1
reduced capital[a]	-18.7	- 2.3	8.4

TABLE 3

INTERNAL RATE OF RETURN TO ORANGE COUNTY

	Years Evaluated		
	10	15	20
Employment, Population Distribution 1			
full capital	.03	.08	.10
reduced capital[a]	.10	.15	.16
Employment, Population Distribution 2			
full capital	<.01	.03	.06
reduced capital[a]	.03	.08	.10

[a]Capital outlay was reduced to $64,700 on the assumption that cost of the sewer extension would be equally shared by the county and the plant.

TABLE 4

NET PRESENT VALUE ($000) OF BENEFITS TO HILLSBOROUGH AT .09 DISCOUNT RATE

	Years Evaluated		
	10	15	20
No Plant Area Incorporation	-204.5	-199.1	-195.6
With Plant Area Incorporation	-117.4	- 82.8	- 60.2

TABLE 5

INTERNAL RATE OF RETURN TO HILLSBOROUGH

	Years Evaluated		
	10	15	20
No Plant Area Incorporation	< .01	<.01	<.01
With Plant Area Incorporation	<.01	.03	.05

[a]Capital outlay was reduced to $64, 700 on the assumption that cost of the sewer extension would be equally shared by the county and the plant.

FIGURE 1
MODEL LINKAGES

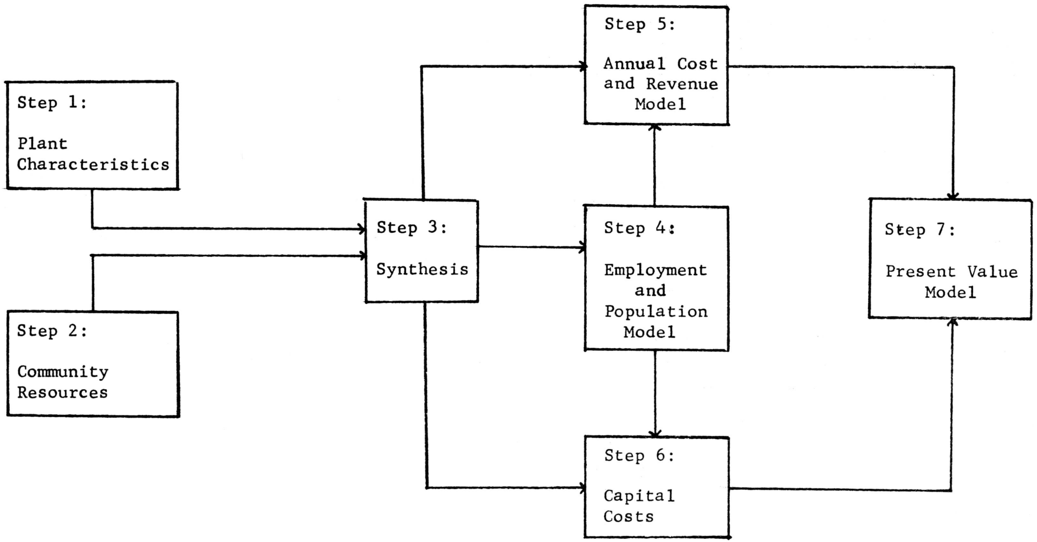

FIGURE 2

POTENTIAL SOURCES OF EMPLOYEES

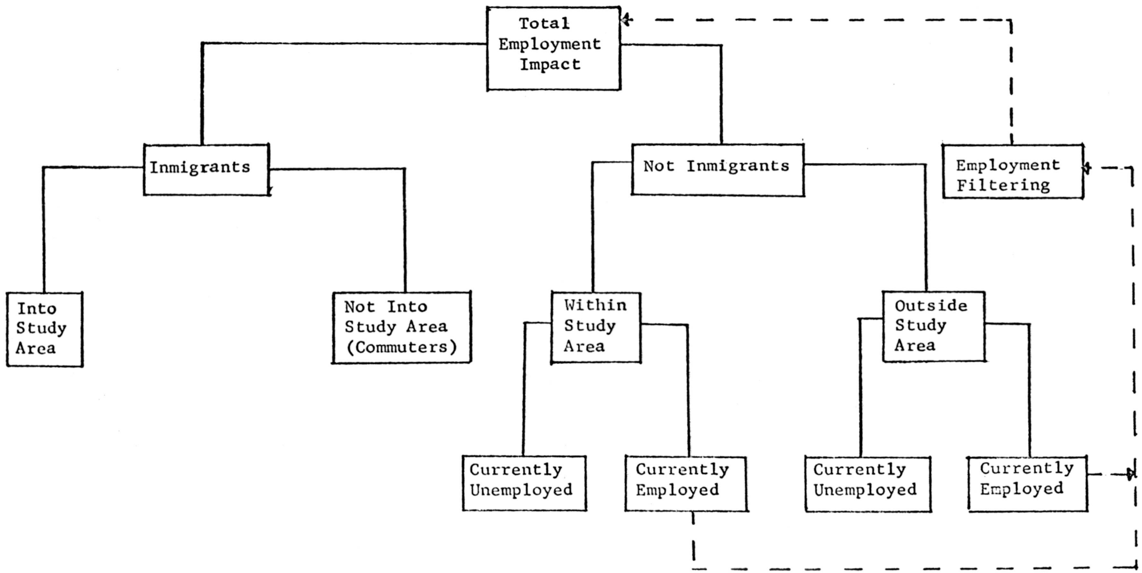

FIGURE 3
HYPOTHETICAL TOTAL EMPLOYMENT AND POPULATION IMPACT DISTRIBUTION

Source:	Total Employment Impact	Population Impact	School Enrollment Impact	Income Impact	Dwelling Unit Impact
Inmigrants					
Into Study Area	g_1	p_1	s_1	y_1	du_1
Commuters	g_2	p_2	s_2	y_2	du_2
Not Inmigrant					
Within Study Area	g_2	p_3	s_3	y_3	du_3
Commuters	g_4	p_4	s_4	y_4	du_4
Total	G	P	S	Y	DU

FOOTNOTES

[1]U.S. Department of Commerce, Industrial Location as a Factor in Regional Economic Development (Washington: Government Printing Office, 1967), p. 57.

[2]Cited in William N. Kinnard, Jr., and Stephen Messner, Industrial Real Estate (Washington: Society of Industrial Realtors, 1971), p. 23.

[3]Richard B. Andrews, The Effects of Industrialization on Six Small Wisconsin Cities (Madison, Wisconsin: School of Commerce, 1959), pp. 9-10.

[4]See: Louis Winnick, "Place Prosperity vs. People Prosperity," in Essays in Urban Land Economics (Berkeley, California: University of California Center for Real Estate and Urban Economics, 1966).

[5]Wall Street Journal (Vol. CLXXVIII, No. 88, November 4, 1971), p.1.

[6]L. T. Wallace, and V. W. Ruttan, "The Role of the Community in Industrial Location," Papers and Proceedings of the Regional Science Association, Vol. 7 (1961), p. 142.

[7]See for example, Arthur A. Thompson, "Industrial Revenue Bonds and Regional Development," The Review of Regional Studies, Vol. 1, Number 1 (Fall, 1970), pp. 185-210.

[8]Walter Isard, and Robert Coughlin, Municipal Costs and Revenues Resulting from Community Growth (Wellesley, Massachusetts: Chandler Davis, 1957), p. 46.

[9]Cited in U.S. Department of Commerce, op. cit. p. 50.

[10]Darwin G. Stuart, and Robert Teska, "Who Pays for What: A Cost-Revenue Analysis of Suburban Land USE Alternatives," Urban Land, Vol.30 (March, 1971), p. 6.

[11]Richard B. Andrews, op. cit., p. 91.

[12]Norton T. Dodge and John H. Cumberland, "Some Environmental Externalities in Regional Development," The Review of Regional Studies, Vol. 1, Number 1 (Fall, 1970), p. 57.

[13]Robert Longabaugh, "Cost-Revenue Implications of Various Land Use Patterns" (unpublished Masters dissertation, Department of City and Regional Planning, University of North Carolina, 1960).

[14]For a brief discussion of this model see: P. D. Henderson, "Investment Criteria for Public Enterprises," in R. Turvey (ed.), Public Enterprise (Middlesex, England: Penguin Books, 1968), pp. 86-172.

[15]R. A. Bauer (ed.), Social Indicators (Cambridge, Massachusetts: The MIT Press, 1966).

[16]Charles Tiebout, "Community Income Multipliers: A Population Growth Model," Journal of Regional Science, Vol. II (Spring, 1960), pp. 75-84.

[17]Werner Z. Hirsch, "Regional Fiscal Impact of Local Industrial Development," Papers and Proceedings of the Regional Science Association, Vol.

7 (1961), p. 129.

[18] _Ibid_, p. 122.

[19] Charles L. Hammon, "Calculating the Profitability of Industrial Land Developments," _Urban Land,_ Vol. 29 (June, 1970), p.10.

[20] Robert Haveman, _Public Expenditures and Policy Analysis_ (Chicago: Markham Publishing Company, 1970), p. 12.

[21] Interview with Orange County engineer, December 3, 1971.