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Socioeconomic Impact Models: An Annotated Bibliography

Marlys Knutson Nelson

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ABSTRACT

This report examines recent literature related to socioeconomic impact, assessment, and planning models. This bibliography contains 31 references to 20 specific impact models. In addition, references are listed for other related topics: survey or summary articles; pertinent quantitative techniques; economic base or econometric forecasting; fiscal models; population and settlement patterns; employment; and coal or energy. It is intended as a research tool for students and users of impact models for their various purposes, notably equilibrium planning, estimating impact effects of development projects, and planning for future contingencies.

Keywords: Socioeconomic analysis, models, bibliography, impact analysis, research planning.

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INTRODUCTION

The study of socioeconomic changes resulting from large-scale development projects has recently become a major research topic. Many socioeconomic impact, planning, and assessment models have been developed in the last decade as a result of this research. Three factors have been behind much of this surge of model building: (1) the passage of Federal and State legislation necessitating the use of impact models, notably the National Environmental Policy Act (NEPA), Public Law 91-190, in 1969, (2) the advent of large mineral development projects in the Western States in the 1970's, and (3) the population turnaround in many rural areas also in the 1970's. NEPA requires systematic and comprehensive analyses of the social, economic, and environmental impacts of major development projects. Impact models do supply this type of information and also allow for other types of changes in a local economy.

This 160-entry bibliography cites recent literature related to large-scale socioeconomic impact models.1/ Of these entries, 31 references to 20 specific models are annotated. The remaining selectively annotated references relate to survey or summary articles, pertinent quantitative techniques, economic base or econometric forecasting, fiscal models, population and settlement patterns, employment, and coal and energy.

AN OVERVIEW OF IMPACT MODELS

Basic techniques for impact assessment have existed for years. Early models included only economic and demographic impacts. As computers became available, more complex models appeared. Recent models include the projection of public service and fiscal impacts. Outputs of these models are now typically at a county or community level.

Impact models serve a wide variety of purposes, aiding planners, policymakers, and the general public: (1) equilibrium planning -- planning for a future

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1/ A companion report describes the structure of these models, their common features, estimation techniques, and the potential research that could contribute to a new generation of models. See Marlys Knutson Nelson and Lloyd D. Bender, "An Overview of Impact Models," forthcoming, Economic Research Service, U.S. Department of Agriculture.

time period without regard for intermediate time periods, (2) educating the user by illustrating the effects of changes in key variables, (3) fulfilling NEPA requirements for a comprehensive analysis of the social, economic, and environmental impacts of major developmental projects, and (4) advanced planning for future contingencies in a given study area. Such a variety of uses suggests that their complexity, their methodologies, and the types of estimates they produce will be quite different.

Models may differ in data needs, structural features, and output, but most recent models have the general capabilities to estimate: (1) the socioeconomic baseline of a given study area (the status quo or "without project" future of the area), (2) the economic and demographic impacts of a development project or some other change from the status quo, (3) the spatial distribution of impacts within a study area, (4) impacts on public services resulting from a project, and (5) tax base changes, particularly for property and sales taxes and fiscal impacts on the various local government entities (municipalities, counties, and school districts).

Local, county, and State governments as well as private groups use assessment models to help them effectively plan for the mitigation of impacts from a wide variety of changes. The problem faced by government planning officials and others is choosing the approach to apply to their specific situation from among the proliferation of models of ever-increasing complexity and detail. Appropriate concerns in the process of model selection include: the purpose of the estimates, the importance of each estimate as ranked by the goals of the analysis, the methodologies behind the estimates, the interpretation of the estimates, and the accuracy of the estimates.

CRITICAL ISSUES

Distinct trends toward similarity in the structures of impact models have been established. Common techniques are used within virtually identical submodel dimensions in many of the recently developed models. In addition, one commonly finds elements of different techniques combined into a single structure. The specification of model structure is important because incorrectly specified equations will generate errors that become magnified as the estimated results of one submodel are used for estimation within another submodel.

Inadequate data bases are an important limitation of impact assessment modeling. It seems that "our capacity to develop highly sophisticated regional models has far outrun our ability to implement them, given the primitive nature of available data and data-gathering techniques" (Miernyk, 1976). Given the data available, however, both modelers and model users should be aware of the statistical properties of the resulting estimates and the problems involved in their estimation and use.

Current technology does not adequately address specific issues that should be incorporated into the modeling framework for purposes of contingency planning and the formation of mitigation strategies: dynamics, prediction of settlement patterns, and uncertainty. Many models implicitly assume that the

economy is static or in equilibrium at least at the point of reference; yet, the local economy is dynamic and probably in a state of constant change. When dynamics are built into a model, the intent is to reveal the period-by-period increments in total regional employment, income, or population given an increase in basic employment brought about by new development projects or some other large change in the local economy.

Methods for accurately predicting settlement patterns are required for an assessment of spillover effects and front-end lags. Spillover effects occur when one county enjoys an increased tax base with little need to increase services because most of the new population has settled in another county. Front-end lags develop when the rapid population growth that accompanies a new development project necessitates additional public services but the means to pay for these services are not immediately available. Then, too, models for impact assessment are not modern-day crystal balls. Uncertainty is a fact of life and applying any impact model cannot provide certainty to a given situation. In fact, "uncertainty is the essence of the planning problem and the public is not well served by a strategy that simply plans for the most likely future" (Chalmers and Anderson, 1977).

ANNOTATED BIBLIOGRAPHY

Specific Socioeconomic Impact Models

(1) Anderson, Eric J. and others. ATOM 2: A Description of ATOM 2 Together with Research Related to Its Development. Bureau of Business and Economic Research, College of Business Administration, Arizona State University, June 1974.

The Arizona Trade-Off Model (ATOM) was first developed in the early 1970's. An improved version, ATOM 2, is documented in this volume.

(2) Anderson, Eric and others. A Guide for the Transfer and Adaptation of ATOM 2. Prepared for Planning Division, Office of Economic Planning and Development, Office of the Governor, State of Arizona, December 1974.

Part I describes ATOM 2 and gives examples of simulations for which the model was developed. Parts II and III provide technical summaries of the development of the economic and demographic submodels. Issues involved in adopting the model to other regions are also discussed. Part IV lists the program.

(3) Battelle Columbus Laboratories. Final Report on Development of the Arizona Environmental and Economic Trade-off Model. Prepared for the Department of Economic Planning and Development, State of Arizona, March 1973.

This summary report describes in general terms how the model (ATOM) works and is used. It identifies and describes the structured major elements and components and specifies the sub-models, basic parameters, data inputs, and data formats.

(4) Beckhelm, Terrance L., James A. Chalmers, and William M. Hannigan. ATOM 3: A Description of ATOM 3 and of the Research Related to Its Development. Arizona Office of Economic Planning and Development, Bureau of Business and Economic Research, and the Department of Economics, Arizona State University, July 1975.

This model updates ATOM 2 in five areas: there is a new data set for fertility and survival rates, Indian subpopulations are treated separately, different family characteristics of construction workers are accounted for, new data are introduced to estimate age-sex characteristics of employment-induced migrants, and educational migration is treated more thoroughly.

Submodels (dimensions) of this model and estimation techniques used are briefly summarized here. An input-output model is used in the employment and income submodel. The population dimension employs a cohort-survival technique. Baseline and impact considerations are both handled. Four separate allocation methods are used to estimate the spatial distribution of impacts. Projections are county-specific, based on historical distributions of activities, based on the technique of location quotients, or based on easily obtained numbers (for example, the number of school-age children in a county). This model does not address the issues of public services impacts or impacts on local government revenues and expenditures.

(5) Bender, Lloyd D. and others. "An Introduction to the COALTOWN Impact Assessment Model." EPA 600/7-80-146. Office of Environmental Engineering and Technology, Office of Research and Development, Environmental Protection Agency, August 1980.

The COALTOWN impact assessment model has three parts: socioeconomic, State and local government revenues, and local government expenditures. It uses "modified" economic base concepts to simulate future employment, population, wage levels, migration, State and local tax receipts, intergovernmental transfers, and local government expenditures. The geographic area encompassed by the model includes counties in Montana, Wyoming, and North Dakota. The model uses lagged variables, implying that interrelationships among variables in the equations produce reverberations in the years following an initial change; that is, it is dynamic.

The original version has been revised by Larry C. Parcels at the Center for Data Systems and Analysis at Montana State University, Bozeman. It contains updated parameter estimates tailored to coal counties, a complex stochastic lag structure, and provisions for disaggregation of population, revenues, and demands for services among local governmental units.

(6) Chalmers, J. A. and E. J. Anderson. "Economic/Demographic Assessment Manual." Prepared for the Bureau of Reclamation, U.S. Department of Interior, November 1977.

Focuses on problems associated with projecting population, employment, and income impacts of the construction and operation phases of water resource development projects. The three sections of the manual are: survey of current practices, procedural recommendations, and a test case. Presents a seven-step procedure for carrying out an economic/demographic assessment.

The model, BREAM, was developed to address the impacts of water resource development projects. It allows for correction in population projections for many subpopulations: ethnic, military, college, and nonlocal construction. It incorporates industry-specific migration propensities and calibrates hierarchical trading relations among contiguous counties in a region. The latter item allows for the consideration of income leakages for central place functions that typically originate in sparsely settled counties where thresholds are too low and terminate in counties having larger urban centers.

Submodels (dimensions) of this model and estimation techniques used are briefly summarized here. An economic base model is employed in the employment and income submodel. The population dimension uses a cohort-survival technique. Baseline and impact considerations ("with" and "without" a project) are included. A gravity model is used for the spatial distribution of impacts. Both public services impacts and fiscal impacts are addressed.

(7) Chalmers, James A. and others. "Atom 2: An Extension of the Arizona Trade-off Model." Arizona Business, Vol. XXI, No. 8 (October 1974), 3-10.

(8) Chase, Robert A. and others. "Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description." Agricultural Economics Miscellaneous Report No. 61. Department of Agricultural Economics, North Dakota State University, undated.

NEDAM was originally designed to provide estimates of economic, demographic, and fiscal changes at both the regional and local levels resulting from alternative scenarios of energy resource use and development in North Dakota. The adapted version of the model for Montana projects personal income at the multi-county regional level and estimates employment, population, and public sector costs and revenues at county and community levels. Projections are made annually for 1981 through 2005.

NEDAM uses an input-output model to estimate economic activities associated with projected levels of the historic economic base for the area and with alternative scenarios of resource development. The demographic submodel employs a cohort-survival method to handle population projections. Allocations of population at the municipal level use a gravity model.

(9) Cluett, C. and J. Jacobsen. Socioeconomic and Demographic Forecasting Model. Battelle Human Affairs Research Centers, U.S. Department of Energy, 1978.

Battelle II will provide the user with two outputs: (1) the most probable estimate of future labor force and population and (2) a set of maximum impact features--lower and upper limits, using extreme assumptions. Seeing this range of possible outcomes may be highly useful to local decisionmakers. The model, however, presents this output in 5-year increments that may not be useful to those wishing to fine-tune mitigation strategies.

Submodels (dimensions) of this model and techniques used are briefly summarized here. An economic base model is used in the employment and income submodel. A cohort-survival technique is used in the population dimension. Baseline and impact considerations are both included. A gravity model is used for the spatial distribution of impacts. Public services impacts are projected by the model. This model does not address fiscal impacts.

(10) Denver Research Institute and Resource Planning Associates. Socioeconomic Impacts of Western Energy Resource Development. Volume II: Assessment Methodologies. Prepared for Council on Environmental Quality, Executive Office of the President, Resource and Land Investigations Program, U.S. Geological Survey, U.S. Department of Energy, Environmental Protection Agency, and National Science Foundation, June 1979.

Gives detailed analyses of assessment needs and alternative approaches for each component of a typical assessment process. Provides a step-by-step description of a demonstration methodology for each component. The demonstration methodology (DRI) is designed for use by State-level impact assessment teams and for facilitating extensive sensitivity testing to explore the implications of uncertainty.

Allocation techniques such as gravity models and programming methods are not used. All residential impacts associated with employment are allocated in the same proportion as employment. The methodology requires the use of local informational inputs and parameters may be adjusted at the discretion of the user.

Submodels (dimensions) of this model and techniques used are briefly summarized here. An economic base model is used in the employment and income submodel. The population dimension employs a cohort-survival technique. Baseline and impact considerations are both included. Public services impacts and impacts on revenues and expenditures are included. This model does not address the spatial distribution of impacts.

(11) Frigerio, N. A. and others. SITE: A Methodology for Assessment of Energy Facility Siting Patterns. ANL/AA-2. Argonne, Illinois: Argonne National Laboratory, August 1975.

Documents the computerized SITE methodology developed to evaluate health, environmental, and socioeconomic impacts related to using alternate sites for energy production within a region of interest. An application is presented.

(12) Governor's Office of Planning Coordination. <u>Nevada's Demographic and Economic Impact Simulation Model</u>, 1978.

DEISM allows for separate population estimations for ethnic subpopulations. Its results are presented for 5-year projection periods. No fiscal impacts are indicated at the county level and none of the county projections are disaggregated to the community level.

Submodels (dimensions) of this model and techniques used are briefly summarized here. The employment and income dimension uses an economic base model. The population submodel employs a cohort-survival technique. Baseline and impact considerations are both addressed. This model considers neither the spatial distribution of impacts nor the impacts of change on public services and local government revenues and expenditures.

(13) Harris, Curtis C., Jr. <u>The Urban Economies, 1985</u>. Lexington, Massachusetts: Lexington Books, 1973.

A multiregional, multi-industry forecasting model is presented in this book. Data are for all U.S. counties, but forecasts are presented for Standard Metropolitan Statistical Areas only. Changes in industry location are the driving force of the model determining a region's growth or decline.

Submodels (dimensions) of this model and techniques used are briefly summarized here. Both an input-output model and econometric techniques are used in the employment and income submodel. The population dimension uses a cohort-survival technique. Baseline and impact considerations are both handled by this model. The model does not address the spatial distribution of impacts, public services impacts, or fiscal impacts.

(14) Johnson, A. William and F. L. Leistritz. <u>The REAP Economic-Demographic Model-1: User Manual</u>. Bismarck, North Dakota: North Dakota Regional Environmental Assessment Program, December 1976.

The model projects economic and demographic factors at the multi-county, county, and municipal levels for 1975 through 1999 under baseline and impact conditions for 15 counties in western North Dakota. The impacts result from single or multiple energy-related developments at alternative sites in the region.

(15) Leistritz, F. L. and others. "A Model for Projecting Localized Economic, Demographic, and Fiscal Impacts of Large-Scale Projects." Western Journal of Agricultural Economics, December 1979, 1-16.

> The expanded REAP model (covering all eight of North Dakota's planning regions) is described in terms of projecting the effects of large-scale developments on business activity, personal income, employment, population, requirements for selected public and quasi-public services, and public sector costs and revenues. Describes the structure, data base, and interrelationships of the model's six major components.

(16) McCarl, Bruce A. and others. Users Guide to the Purdue Development Model Computer Program. Bulletin No. 94. Agricultural Experiment Station, Purdue University, September 1975.

(17) Mills, Edwin S. "A Critical Evaluation of 'The Community Analysis Model'." Prepared for the U.S. Department of Housing and Urban Development, August 1978.

> The Community Analysis Model (CAM) is a model of growth and change in urban neighborhoods. Researchers at the Massachusetts Institute of Technology prepared it. This report critically evaluates the model, emphasizing its underlying theoretical structure.

(18) Minshall, C. and others. "Development of the Arizona Environmental and Economic Trade-off Model." Prepared for the Department of Economic Planning and Development, State of Arizona, April 30, 1973.

(19) Monts, J. and E. Bareiss. Community-level Impacts Projection System. Center for Energy Studies, University of Texas at Austin, Texas Energy Advisory Council, 1979.

> CLIPS is an interactive model allowing the user to participate in the modeling by specifying local conditions or changing values of model parameters. Some other models also allow for this interaction. Nonbasic employment induced by construction workers is not considered by this model, implying that the baseline projections are probably more accurate than its impact projections.
>
> Submodels (dimensions) of this model and techniques used are briefly summarized here. The employment and income submodel uses an economic base model. A cohort-survival technique was used in the population dimension. Baseline and impact considerations are

both handled by the model. A gravity model is used to assess the spatial distribution of impacts. Public services impacts and fiscal impacts are both addressed.

(20) Mountain West Research, Incorporated. "Bureau of Reclamation Economic Assessment Model (BREAM): Technical Description." Prepared for Bureau of Reclamation, U.S. Department of Interior, January 1978.

The logic and quantitative relationships of each of the five submodels of BREAM are examined. The five submodels are demographic, construction worker, economic, labor market, and community allocation.

(21) Murdock, S. and others. The Texas Assessment Modeling System: User Manual. Center for Energy and Mineral Resources, Texas Rural Development Program, Texas Agricultural Experiment Station, 1979.

The TAMS model is derived directly from North Dakota's REAP model. Submodels (dimensions) of this model and techniques used are briefly summarized here. An input-output model is used in the employment and income submodel. The population dimension employs a cohort-survival technique. Both baseline (without a project) and impact (with a project) considerations are handled. A gravity model is used for spatial distribution of the impacts. Both public services and fiscal impacts are addressed.

(22) Murphy/Williams Urban Planning and Housing Consultants. Socioeconomic Impact Assessment: A Methodology Applied to Synthetic Fuels. HCP/L2516-01; UC-13. U.S. Department of Energy, April 1978.

Eleven mining-dominant counties were selected for analysis. A community development model (SIA) estimates economic, demographic and social, land use, and local government impacts from synthetic fuels developments.

All impact estimates made by the model are of the gross variety; that is, they do not deal with marginal or net changes that take place from one year to the next. Unique to this model, a multiplier methodology estimates building space requirements for retail, commerce, business, and manufacturing establishments. These are then translated into land requirements. Many of the features of the more comprehensive models are missing, however. It lacks a labor market analysis and provision for baseline projections.

Submodels (dimensions) of this model and techniques used are briefly summarized here. The employment and income submodel uses an economic base model. A complex procedure is used in the population submodel. Public services and fiscal impacts are both

projected by the model. Impacts of the project only are addressed; that is, no baseline (without project) projections are given. The model does not estimate the spatial distribution of impacts.

(23) Obermiller, Frederick W. and others. The Purdue Development Model: An Interactive Approach to Modeling Population Growth and Economic Development - An Overview. Research Bulletin No. 926. Agricultural Experiment Station, Purdue University, October 1975.

This model emphasizes development of the agricultural sector, but agricultural-nonagricultural interactions in the development process are recognized. The model is a national model incorporating international migration rates.

(24) Reeve, Ross, Rodger Weaver, and Eric Natwig. "The Navajo Economic-Demographic Model: A Method for Forecasting and Evaluating Alternative Navajo Economic Futures. (Volume 1: A Technical Description of the Model)." Office of the State Planning Coordinator, Office of the Governor, Utah, and Office of Program Development, The Navajo Nation, Window Rock, Arizona, undated.

The Navajo Economic-Demographic (NED) model produces economic and demographic information for each of five Navajo agencies and four off-reservation border areas in Arizona, New Mexico, Colorado, and Utah. Projections are made at 5-year intervals with 1975 serving as the base period. Demographic output includes both Navajo and non-Navajo population by 5-year age, sex, and broad occupational cohorts for each of the nine areas. NED economic outputs relate to labor supply, job opportunities, and employment both before and after migration and commuting for each 5-year period and each area. The model combines a cohort-survival population model and an economic base employment model.

(25) Schmidt, David and Gary Yaquinto. ADAS II Summary Report. Economic Research Unit, State Planning Coordinator's Office, Wyoming, April 1977.

The Analysis of Development Alternative System (ADAS II) projects population and employment for each Wyoming county. The three components of the model are demographic, employment, and labor market.

(26) Seiver, Daniel A. "Alaskan Economic Growth: A Regional Model with Induced Migration." Paper presented at the annual meeting of the Regional Science Association, Cambridge, Massachusetts, November 1975.

Summarizes a model of the Alaskan economy. It is made up of economic and demographic submodels with a provision for economic-demographic links through net migration. Presents three alternative "petroleum scenarios" for 1970-1990 (limited, accelerated, and maximum development).

(27) Stenehjem, Erik J. <u>Summary Description of SEAM: The Social and Economic Assessment Model</u>. ANL/IAPE/TM/78-9. Argonne, Illinois: Argonne National Laboratory, April 1978.

The data and models of SEAM can be used to provide the following outputs for any county or combination of counties in the continental United States: annual population projections by age, sex, and race; annual direct employment requirements of most forms of energy extraction and conversion facilities; annual estimates of indirect employment requirements created by a new energy or industrial facility; annual projections of the locally available workforce; annual projections and characterizations of in-migrating worker households induced to the county by the new facility; annual housing needs and the sub-county spatial allocation of new population; and annual additional public service requirements and their costs.

In the SEAM II model, three distinct employment multipliers are presented: (1) a simple ratio (total employment divided by basic employment), (2) a complex ratio, and (3) one based on cross-sectional analysis of employment data. Each would apply to the following cases: (1) the county's present economy is similar to its 1970 economy, (2) used only when it is known with certainty that any estimate of direct employment for the project is strictly basic employment, and (3) used when the county is undergoing changes in population or employment, is characterized by a narrow export base, or is simply a small economic unit. The model also considers the issue of how the multiplier effects unfold over time. Baseline labor demands in a county are not considered. This implies that future employment levels are probably underestimated as are all related socioeconomic characteristics of the county.

Submodels (dimensions) of this model and techniques used are briefly summarized here. An economic base model is used in the employment and income submodel. The population dimension uses a cohort-survival technique. Baseline and impact considerations are both addressed by the model. A linear programming model is used for the spatial distribution of the impacts. The model addresses both public services and fiscal impacts.

(28) Temple, George Sterling. "A Dynamic Economic Systems Community Impact Model Applied to Coal Development in the Northern Great Plains." EPA-LAG-D6-E766. Prepared by Economics, Statistics, and

Cooperatives Service, U.S. Department of Agriculture with the cooperation of Montana State University for the Office of Research and Development, Environmental Protection Agency, May 1978.

The dynamics behind a development project are built into COALTOWN II's statistically estimated equations. This allows a project's impacts to reverberate through the county economy over a period of years. Net migration is estimated in this model and not taken directly from Census reports as is typically done in many of the others. The reliability of the input data is emphasized as an important ingredient for any useful projections from the model. This model has been criticized for its "black box" approach, implying it might be more difficult to explain to users.

Submodels (dimensions) of this model and techniques used are briefly summarized here. Economic base and econometric models are combined in the employment and income submodel. A complex procedure is used in the population submodel. Baseline and impact considerations are both handled by the model. Fiscal impacts are projected. The model addresses neither the spatial distribution of the impacts nor the projections of public services impacts.

(29) Toman, N. and others. REAP Economic-Demographic Model: Technical Description. North Dakota Regional Environmental Assessment Program, 1978.

Under impact conditions, REAP II projects four separate types of labor force requirements: baseline, construction, operation, and indirect labor. Its service module addresses education, housing, medicine/health, and criminal justice. Since its economic submodel is based on input-output analysis, all the strengths and weaknesses associated with I-O may be mentioned about REAP II: (1) requires a large amount of primary data to develop an I-O table if one is not available, (2) technical coefficients of the interindustry transactions matrix are assumed to be constant, making it difficult to represent technological change and productivity adjustments in the system, and (3) models are usually static since dynamic features are difficult to incorporate into the model. (See Pleeter for additional discussion.) The TAMS model is directly derived from this model.

Submodels (dimensions) of this model and techniques used are briefly summarized here. An input-output model is used in the employment and income dimension. A cohort-survival technique is employed in the population submodel. Baseline and impact considerations are both handled by the model. A gravity model is used for the spatial distribution of the impacts. Public services and fiscal impacts are both projected by this model.

(30) White, T. Kelley and others. The Purdue Development Model: A
      Systems Approach to Modeling Demographic-Economic Interaction in
      Agricultural Development. Research Bulletin No. 925.
      Agricultural Experiment Station, Purdue University, October 1975.

      Submodels (dimensions) of this model and techniques used are
      briefly summarized here. Linear programming is used in the
      employment and income submodel. A cohort-survival technique is
      used in the population dimension. The model handles both baseline
      and impact considerations. Public services impacts (especially
      education, medical services, and research and extension services)
      are projected. Fiscal impacts are also addressed. The model does
      not address the spatial distribution of impacts.

(31) Woods, Michael Denton. "A Simulation Model for Rural Communities in
      Oklahoma." Ph. D. dissertation. Oklahoma State University, 1981.

      The Oklahoma model, OCDSM, is specifically designed to analyze
      community-level impacts. It uses a community-specific I-O model
      derived from a regional (State) I-O model by a location quotient
      technique. Unique to this model, a gravity model has been used to
      determine a community's service (impact) area, an area bounded
      by "points of indifference." Although users are encouraged to
      supply local data, the modelers have stored "default" data that
      may be used to run the model when local data are not available.
      The model projects annual levels of employment and income by
      economic sector; population by age-sex cohort for the community
      and its service area; community service demand; and community
      revenue by source. The community service dimension of this model
      is much more detailed than most others, including estimates of
      hospital bed days, physician visits, ambulance and fire calls,
      water use, and wastewater and solid waste generated.

      Submodels (dimensions) of this model and techniques used are
      briefly summarized here. An input-output model is used in the
      employment and income submodel. A cohort-survival technique is
      employed in the population submodel. The model handles both
      baseline and impact considerations. A gravity model is used for
      the spatial distribution of the impacts. The model projects both
      public services and fiscal impacts.

Surveys or Summaries

(1) Cohen, Alan S. and Kenneth W. Costello. <u>Regional Energy Modeling:</u>
    <u>An Evaluation of Alternative Approaches.</u> ANL/AA-1. Argonne,
    Illinois: Argonne National Laboratory. Prepared for the U.S.
    Energy Research and Development Administration, June 1975.

    Evaluates eight energy models in terms of model comprehen-
    siveness, economic aspects, and model capabilities. They are
    categorized into "local impact" and "national synthesis" groups.

(2) Dalsted, Norman L. and F. Larry Leistritz. <u>A Selected Bibliography</u>
    <u>on Coal-Energy Development of Particular Interest to the Western</u>
    <u>States.</u> Agricultural Economics Miscellaneous Report No. 16.
    Agricultural Experiment Station, North Dakota State University,
    April 1974.

    Literature reviewed concerns the economic and social problems
    posed by the development of coal resources in the Western States.
    Includes publications from the areas of law, economics,
    engineering, and some biological sciences.

(3) Denver Research Institute and Browne, Bortz and Coddington.
    <u>Socioeconomic Impacts of Power Plants.</u> EPRI EA-2228. Palo
    Alto, California: Electric Power Research Institute, February
    1982.

    Summarizes a 2-year study of the socioeconomic impacts resulting
    from power plant construction and operation. The research is
    based on 12 retrospective case studies of power plants. Impact
    assessment models are reviewed and classified. Actual and
    projected construction employment differed considerably. The
    geographic extent of site influence was generally greater than
    expected. Secondary economic impacts, including employment
    multipliers, were found to be relatively minor. Also assesses
    housing demand and supply and local government fiscal impacts.

(4) Energy Information Administration, U.S. Department of Energy.
    <u>Applied Analysis Model Summaries.</u> Technical Report
    DOE/EIA-0293. December 1980.

    Contains information on models or modeling systems used by the
    Office of Applied Analysis, Energy Information Administration.
    Summarizes each model's purpose, characteristics, uses, and
    requirements.

(5) Frankena, Frederick. <u>Community Impacts of Rapid Growth in</u>
    <u>Nonmetropolitan Areas: A Literature Survey</u>. Rural Sociology

Series No. 9. Agricultural Experiment Station, Michigan State University, June 1980.

This survey of literature was derived by a computer-aided search of the <u>Social Science Citation Index</u>. Literature cited shows the range, type, and specific concerns of sources about impacts of nonmetropolitan growth. Categories covered include boomtowns and rapid development; controlling, managing, and planning growth; growth related to energy development; population migration turn-around; and rural industrialization.

(6) Pleeter, Saul (editor). <u>Economic Impact Analysis: Methodology and Applications</u>. Papers from a 1977 workshop on the methodology of economic impact analysis. Boston: Martinus Nijhoff Publishing, 1980.

(7) Richardson, Harry W. "The State of Regional Economics: A Survey Article," <u>International Regional Science Review</u>, Vol. 3, No. 1 (Fall 1978), 1-48.

Reviews regional economics research in the areas of theory, methods, and policy. Theoretical topics include spatial prices, location, regional growth, and spatial diffusion. Methods section discusses economic base, regional input-output, regional econometric, shift-share, and gravity models.

Quantitative Techniques

(1) Bohm, Robert A. and James H. Lord. "Regional Economic Simulation
Modeling--The TVA Experience." Paper presented at the annual
meetings of the Northeast Regional Science Association, University
Park, Pennsylvania, April 1972.

(2) Bradford, Garnett L. and Fred B. Saunders (editors). Quantitative
Techniques with Application to Rural Development Research.
Papers presented to the Southern Farm Management Research
Committee, The Farm Foundation, November 1971 (printed March
1972).

These papers evaluate the efficacy of applying quantitative
techniques frequently used in farm management and production
economics research to rural development research.

(3) Braschler, Curtis. Regional Growth Models--An Analytical Approach
in Missouri 1950 to 1970. Research Bulletin No. 996.
Agricultural Experiment Station, University of Missouri-Columbia,
March 1973.

(4) Chalmers, J. A. "Incorporating Spatial Interaction in Economic Impact
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(18) Williams, Daniel G. Use of Multiple Regression Analysis to
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(10) Edwards, Clark and Rudolph DePass. Alternative Futures for
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isolation each may have undesirable side effects on migration,
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needs for facility construction are examined. Evaluates a variety
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criteria.

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Addresses two questions. Also presents longrun growth paths,
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(21) _____. "Community and Environmental Impact Assessment: A
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Change, October 1975, 32-36.

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for use in planning for public service provision.

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(3) Kutak, Rock, Cohen, Campbell, Garfinkle, and Woodward. A Legal
Study Relating to Coal Development--Population Issues. Vol. 1.
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(2) governmental reactions, and (3) principles for legislation.

(4) Murdock, Steve H., James S. Wieland, and F. Larry Leistritz. "An
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Community Settlement Patterns in Rural Energy-Impacted Areas in
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National Statistics, Assembly of Behavioral and Social Sciences,
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NUREG/CR-2421. Employment Standards Administration, U.S.
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cohort groups within the nine States encompassed by the Old West
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(8) Nordlund, Willis J. and R. Thayne Robson.   <u>Energy and Employment</u>.
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      Develops a three-equation model for 25 counties in the Texas
      Panhandle to link changes in basic employment to changes in per
      capita community service expenditures. Per capita expenditures
      declined to a minimum of $186 at a population of about 57,000,
      then increased for higher population levels. An additional job
      created in mining or manufacturing sectors in the region caused
      greater declines in per capita community services expenditures
      than an additional job in agriculture at population levels below
      57,000; above 57,000, expansion in mining or manufacturing causes
      greater increases in per capita expenditures than does
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Provides planners in Montana, North Dakota, and Wyoming with a detailed comparison and explanation of existing coal and energy forecasts. Comparison of the forecasts stresses their usefulness for planners.

(2) Baldwin, Thomas E. and others. <u>A Socioeconomic Assessment of Energy Development in a Small Rural County: Coal Gasification in Mercer County, North Dakota, Volume 1</u>. ANL/AA-5. Argonne, Illinois: Argonne National Laboratory, August 1976.

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(4) Battelle Pacific Northwest Laboratories. <u>Regional Analysis of the U.S. Electric Power Industry</u>. BNWL-B-415-V1. Prepared for the U.S. Energy Research and Development Administration, July 1975.

(5) _____. <u>Regional Analysis of the U.S. Electric Power Industry</u>. Volume 2. <u>Linear Programming Simulation</u>. BNWL-B-415-V2. Prepared for the U.S. Energy Research and Development Administration, June 1975.

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(11) Bernknopf, Richard. "The Marginal Cost of Conforming to Sulfur Emission Standards for Coal." Unpublished. U.S. Geological Survey, July 1979.

(12) Bivins, Robert and others. "ROCKY--An Energy-Environmental Model of Coal and Electricity Supply in the Rocky Mountain West." Paper presented at the Coal Modeling Conference, Bozeman, Montana, July 25-26, 1979.

(13) Booz, Allen, and Hamilton Inc. "A Procedures Manual for Assessing the Socioeconomic Impact of the Construction and Operation of Coal Utilization Facilities in the Old West Region." Prepared for the Old West Regional Commission, June 1974.

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(15) Childress, J. Philip. "The Crux of Long-term Coal Demand: The Market Penetration of Nuclear." Office of Applied Analysis, Energy Information Administration, U.S. Department of Energy, July 1978.

(16) Church, Richard L. and Edward L. Hillsman. "The Oak Ridge SCOAL Models." Energy Division, Oak Ridge National Laboratory. Prepared for Office of Technology Impacts, U.S. Department of Energy, undated.

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(17) Department of Housing and Urban Development, Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action. March 1976.

(18) Department of Mineral Economics, College of Earth and Mineral Sciences, Pennsylvania State University. "Economic Analysis of Coal Supply: An Assessment of Existing Studies." EPRI EA-496. Prepared for Electric Power Research Institute, August 1977.

(19) Green, John W. "The Interregional Coal Analysis Model." Unpublished. Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, July 1979.

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(29) Mountain West Research, Inc. Fact Book for Western Coal/Energy Development. Prepared for the Missouri River Basin Commission and the Resource and Land Investigations Program, U.S. Geological Survey, January 1979.

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(30) _____. A Guide to Methods for Impact Assessment of
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     River Basin Commission and the Resource and Land Investigations
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(31) _____. Source Book for Western Coal/Energy Development.
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     transportation, legislation, and primary and secondary impacts.

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(33) Quality Development Associates, Inc. "A Basic User's Guide to Social
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     Assessment." October 1979.

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     describes components and objectives of each model and assesses
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(35) Santini, Danilo J., David W. South, and Erik J. Stenehjem.
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     from Energy Development." Argonne, Illinois: Argonne National
     Laboratory, June 1979.

(36) Spangler, Don and Lynda Given. "Coping with Growth: Energy Impacts
     in Five Appalachian Counties." National Association of Counties
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     the nature and impacts of energy development and methods for
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Framework presented allows energy planners to estimate the size and timing of population and employment changes associated with eight different energy technologies. A demographic model is used to derive annual population changes resulting from in-migrating workers and their families. Hypothetical examples illustrate use of the methodology.

(41) _____. "A Framework for Projecting Employment and Population Changes Accompanying Energy Development--Volume II." ANL/AA-14, Vol. II. Argonne, Illinois: Argonne National Laboratory. Prepared for the U.S. Department of Energy, May 1980.

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Massachusetts Institute of Technology. Prepared for the U.S. Energy Research and Development Administration, May 1977.

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(44) Stinson, Thomas F., Lloyd D. Bender, and Stanley W. Voelker. Northern Great Plains Coal Mining: Regional Impacts. Agriculture Information Bulletin No. 452. Economic Research Service, U.S. Department of Agriculture, July 1982.

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(45) Susskind, Lawrence and Michael O'Hare. "Managing the Social and Economic Impacts of Energy Development: Strategies for Facility Siting and Compensating Impacted Communities and Individuals." Laboratory of Architecture and Planning, Massachusetts Institute of Technology. Prepared for the U.S. Department of Energy and the Rockefeller Foundation, December 1977.

(46) Teknekron Research, Inc. Utility Simulation Model Documentation Volume 1: Overview, Model Outputs, and Analytic Structure. Prepared for Office of Energy, Minerals, and Industry, Office of Research and Development, Environmental Protection Agency, July 1979.

The computer model projects the annual operations of utilities in each State in response to government policies or alternative decisions affecting the industry.

(47) Vogely, William A. (editor). Mineral Materials Modeling: A State-of-the-art Review. Washington, D.C.: Resources for the Future, December 1975.

(48) Yabroff, Irving W. and Edward M. Dickson. "Coal Resources Model: An Impact Analysis Tool." Prepared for the Office of Transportation Programs, U.S. Department of Energy, January 1980.

General Literature

(1) Bender, Lloyd D. and J. J. Kropf. "Equity and Efficiency Trade-offs in Regional Development." Unpublished. Economic Research Service, U.S. Department of Agriculture, January 1975.

Reviews the classical interregional resource allocation model. Describes equity and efficiency outcomes, using the model. Then the lack of responsiveness to interregional wage and income differentials are incorporated into the model. Empirical changes in equity and labor efficiency in response to new capital formation in four distressed regions of the nation are related to the model.

(2) Chalmers, James A. and Terrance Beckhelm. "Shift and Share and the Theory of Industrial Location." Unpublished. Bureau of Business and Economic Research, College of Business Administration, Arizona State University, 1974.

(3) d'Arge, Ralph C., David S. Brookshire, and Rexford D. Adams. "Are Boomtowns Bad?" Resource and Environment Economics Laboratory, University of Wyoming, February 1978.

(4) Leistritz, F. Larry, Donald M. Senechal, and Laurent Low. "Socioeconomic Effect of Energy Development: The Role of Impact Models in Policy Making." Paper presented at the First National Energy Policy Conference, West Virginia University, May 1, 1980.

(5) Mirchandani, Pitu, F. Imbrogano, and N. Faris. "A Dynamic Model of the Urban Process." DOT-RSPA-DPB-50/81/14. Prepared for Research and Special Programs Administration, U.S. Department of Transportation, March 1981.

Models three major components of the urban process: (1) trip behavior (work and nonwork trips), (2) residential location decisions, and (3) service location decisions. Applications illustrate the feasibility and importance of modeling the dynamics and transients in the urban process for policy analyses.

(6) Reeve, Ross and Rodger Weaver. "Modeling Requirements in Government Decision Making Processes: A Concept Paper." Unpublished. Utah State Planning Coordinator's Office, January 1976.

(7) Rogstad, B. K. and others. "Analysis of Alternative Subsidy Programs: Impact on Regional Development." Prepared for the Economic

Development Administration, U.S. Department of Commerce, August 1973.

Summarizes a methodology which gauges the relative advantages of alternative assistance forms in meeting EDA's goal of accelerating economic development and thereby enhancing opportunities for local residents. The model assesses relative cost-effectiveness for alternative programs over all regional designations and industries of interest to EDA. It was found that the relative effectiveness of alternative forms of subsidy assistance varies greatly over regions and policy goals. Therefore, there is no one universally preferred form of subsidy.

(8) Schmidt, David and Gary Yanquinto. Analysis of Development Alternatives for the State of Wyoming: Summary Report. Economic Analysis Unit, Wyoming Department of Economic Planning and Development, September 1975.

(9) Water Resources Research Institute. "North Platte and Powder River Economic Simulation Models." Unpublished. Undated.

These models are adaptations of a regional economic simulation model prepared for the Battelle Memorial Institute and the University of Alabama by the Tennessee Valley Authority. The modifications made the model more sensitive to resource-oriented developments.

(10) Western Coal Planning Assistance Project Staff. Phase I Final Report. Prepared for the Missouri River Basin Commission and the Resource and Land Investigations Program, U.S. Geological Survey, February 1979.