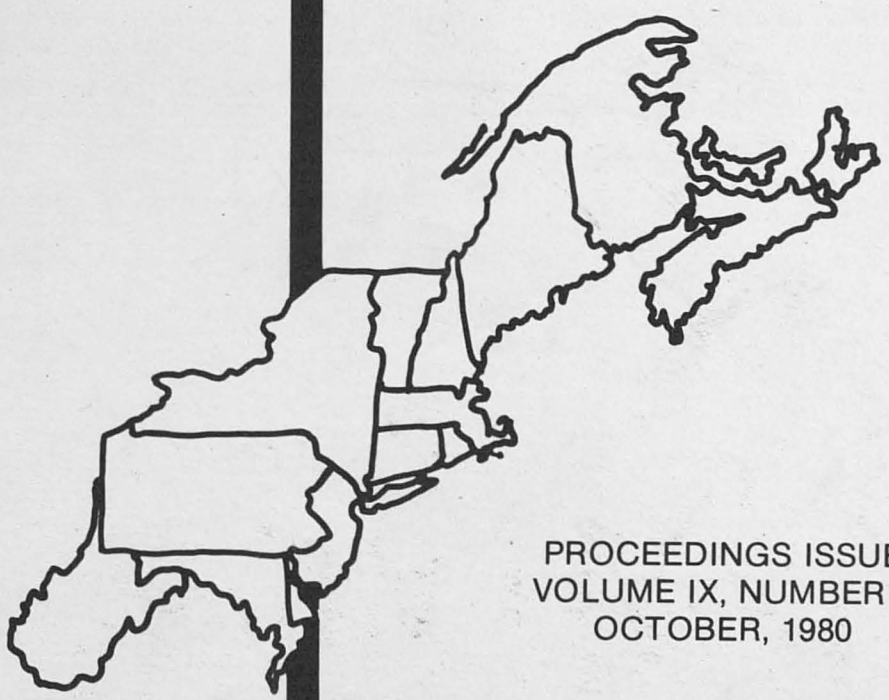
JOURNAL OF THE

Northeastern Agricultural Economics Council



PROCEEDINGS ISSUE
VOLUME IX, NUMBER 2
OCTOBER, 1980

APPLICATION OF AN ECONOMIC BASE MODEL FOR COMMUNITY PLANNING: THE CASE OF KILLINGLY, CONNECTICUT

Joseph E. Diamond and Daniel A. Lass

INTRODUCTION

Economic base studies are an accepted economic tool for regional economic analysis. The economic base concept was first set forth as early as 1928 in a regional study of New York City. The economic base concept gained maturity through the work of Homer Hoyt in the 1930's. The first complete statement of the theory of economic base is contained in a text written by Weiner and Hoyt.

Since the time of those early writings the economic base concept has been refined by a number of economists. Pfouts presents an organized collection of some of the more important writings on the economic base framework. Tiebout presented a detailed and readable description of the economic base study in his classic paper *The Community Economic Base Study*. Andrews and Nelson have contributed to the application of economic base analysis to small areas and rural economies.

Methods of economic analysis are often ignored by local planners. A region's planning may be seriously handicapped by the lack of an appropriate analytical framework for evaluating economic impacts. While more and better data are also needed, the first priority is an analytical framework so that data collected are relevant to the planning function.

The town of Killingly is undergoing significant changes in industrial development. An industrial park encompassing some 300 acres of fields and woodland is included in the Killingly Plan of Development. The application of an economic base model to the case of industrial development in Killingly, Connecticut provided the opportunity to develop further this economic tool and set guidelines for its use. The model presented stresses the utilization of secondary sources of data since they greatly reduce the cost and time involved in the analysis.

OBJECTIVES

The basic objectives of this study were:

1. To determine the sources of basic (export) activity in the town of Killingly and the surrounding trade area and to calculate a basic employment multiplier for the area.
2. To analyze the economic impacts which will occur in terms of total employment changes due to the industrial developments in Killingly.

RESEARCH PROCEDURE

Initially it was necessary to determine the area within which the impact of employment changes are expected to occur. Central place theory was used to delineate the study area. The towns of Killingly and Putnam have been selected as central places for this study. The complementary area for the two central places included the ten townships in the Northeastern Connecticut Planning Region (NCPR).[1] A survey conducted in 1976 by the Northeastern Connecticut Regional Planning Agency found that approximately 73% of the persons living within the NCPR who were surveyed usually shop in this 10-town region (Northeastern Connecticut Regional Planning Agency, p. B16). In addition, 83% of these persons who shop within the region usually shop in the towns of Killingly and Putnam (Northeastern Connecticut Regional Planning Agency, p. B15).[2] These statistics support the decision of selecting Killingly and Putnam as central places and the surrounding eight townships as the complementary area. Those persons surveyed were also asked where they were employed. It was reported that 74% of those surveyed worked within the region (Northeastern Connecticut Regional Planning Agency, p. B12). The above survey results support our decision to define the NCPR as our study area.

It is necessary to determine the amounts of basic and non-basic employment before the responses to a change in basic employment can be estimated. Two indirect methods of determining the basic and non-basic employment are utilized in this paper; the assumption approach, and the location quotients technique. The assumption approach is by far the simplest method of analysis. It is assumed that certain industrial sectors are basic and all others are non-basic.[3] This approach is reasonable when applied to small rural economies such as the NCPR. The use of location quotients is based on the simple premise: if a community or area specializes in the production of a good or service it is presumed that the good or service is an export item. Location quotients are used to determine the industries in which an area is specialized and the amounts of basic and non-basic employment in each industry. National data are used to calculate the location quotients. It is assumed that the consumption patterns in the NCPR are similar to those of the nation.

Using the location quotient technique, the basic and non-basic employment for the i-th industrial sector is calculated as follows:

(1) $$E_i/E \gtrless NE_i/NE \text{ or } E_i \gtrless (NE_i/NE) \times E$$

(2) If: $$E_i \leq (NE_i/NE) \times E$$

then: $$NBE_i = E_i$$

$$BE_i = 0$$

Joseph Diamond is Assistant Professor of Community Resource Development, Department of Agricultural Economics and Rural Sociology, University of Connecticut, and Daniel A. Lass is a graduate assistant, Department of Agricultural Economics and Rural Sociology, University of Connecticut. This paper results from funds of Storrs Agricultural Experiment Station project 530, "An Economic Base Framework for Use in Community and Regional Planning in Connecticut." The authors would like to acknowledge the helpful comments of Marilyn A. Altobello.

[1] The ten townships are Brooklyn, Canterbury, Eastford, Killingly, Plainfield, Pomfret, Putnam, Sterling, Thompson and Woodstock.

[2] The use of the word "town" is in reference to the minor civil divisions of Connecticut.

[3] The most frequently used assumptions are that agriculture, mining and manufacturing are basic activities and all other sectors are non-basic. This can be altered by persons familiar with the local economy and by a higher degree of disaggregation.

(3) If: $E_i > (NE_i/NE) \times E$

then: $NBE_i = (NE_i/NE) \times E$

$BE_i = E_i - NBE_i$

(4) $NBE = \sum_{i=1}^{n} NBE_i$

(5) $BE = \sum_{i=1}^{n} BE_i$

where: E_i = area employment in industry i.
E = total area employment.
NE_i = national employment in industry i.
NE = total national employment.
i = the i-th industry. (i = 1, 2, 3, ..., n).
NBE_i = area non-basic employment in industry i.
BE_i = area basic employment in industry i.
NBE = total area non-basic employment.
BE = total area basic employment.

Summation across n industrial sectors, equations (4) and (5), yields the total non-basic and basic employment for the study area.

The employment multiplier is calculated as follows (Nelson, p. 90):

(6) $ESNW = (NW/POP) \times NBE$

(7) $MULT = (E - ESNW) / BE$

where: ESNW = area non-basic employment serving persons neither working in nor supported by workers in the local labor force.[4]
NW = those persons neither neither working in nor supported by workers in the local labor force.
POP = total area population.
MULT = the employment multiplier for the study area.

The multiplier is applied to the change in basic employment to estimate the change in total employment.[5] Assume that the new basic jobs will be filled by either in-migrating workers or previously unemployed workers. If the rate of unemployment in the study area is above the "full employment" level, an adjustment must be made for the number of unemployed persons hired.[6] The amount of unemployment compensation previously received by these workers represents a "leakage" to the multiplier process. The multiplier is applied only to the additional income which these workers receive by accepting a job.[7] New basic employment filled by in-migrating workers will result in a full multiplier effect on the local economy.

Employment changes in the study area can be expressed mathematically as:

(8) $\Delta BE = E_m + E_u$

(9) $\Delta BE_a = E_m + E_u (1 - \frac{C}{W})$

(10) $\Delta E = (E_m + E_u (1 - \frac{C}{W})) \times MULT + E_u (C/W)$

where: ΔBE = change in area basic employment.
ΔBE_a = adjusted change in area basic employment.
E_m = in-migrating workers hired.
E_u = unemployed workers hired.
C = annual level of unemployment compensation for the study area.
W = annual income for the new jobs created.
ΔE = change in total area employment.

An economy operating at full employment will have the full multiplier effect for all jobs created. It is important to note that although the new jobs filled by unemployed workers will not stimulate the local economy by a full multiplier effect, they are included to the full extent when calculating the total change in employment for the area. The final term in equation (10) makes this necessary adjustment.

The changes in total area employment can be used to estimate changes in the area population and additional tax revenues expected from the industrial developments.

EMPIRICAL RESULTS

Primary data were collected through interviews with persons knowledgeable of the changes in development. The present plan for the park is to attract 10-15 firms of 50-60 employees each. This will serve to create a diversified economic base for the economy. Increased employment from the Frito-Lay plant has been estimated from engineering plans for the factory under construction. At the date when production will begin, 200 persons will be employed. Approximately 6-9 months from that date (June 1980) it is anticipated the plant will be operating at full capacity employing 600 persons.

The above factors were combined to provide a range of possible primary employment changes. Situation A, considered the primary employment change from the Frito-Lay plant. This represents a reliable estimate for the impacts which will occur within the next year and was included in all the hypothetical situations. Four additional hypothetical situations were added according to the level of development for the Killingly Industrial Park. Situation B considered the addition from the Frito-Lay plant plus the primary effects of 10 firms locating in the Killingly Industrial Park and hiring 50 employees each. Similarly, situations C, D and E considered the change associated with Frito-Lay plus 10 plants hiring 60 employees, 15 plants hiring 50 employees, and 15 plants hiring 60 employees, respectively. These hypothetical situations are summarized in Table 1. The totals represent the amount of primary employment change in the area after an adjustment for unemployment in the study area.

It was necessary to adjust the primary employment change because of the high rate of unemployment within the study area. The study area is consistent with the delineation of both the NCPR and the Danielson Labor Market Area. The rate of unemployment for this area was estimated at 7.1% for August of 1979 (Connecticut Labor Department). This represents approximately 2200 workers.

---

[4]See Lass and Diamond 1980b. pp. 19-20 for the estimation of ESNW and calculation of employment multipliers for the Northeastern Connecticut Planning Region.

[5]The employment multiplier must be applied only to that portion of the new employment which is basic (export) activity.

[6]The "full employment" level is consistent with a certain rate of unemployment which represents "frictionally" unemployed persons. It is common to consider a 4% or 5% rate of unemployment representative of "full employment." See Bronfenbrenner (pp. 15-18).

[7]The adjustment for unemployment must be expressed in terms of "jobs," the unit of measurement used in the model. To do this we selected a standard salary (W) to represent the money value of a job. The ratio of unemployment compensation (C) to the standard salary (W) is a pure number which can be used to determine what fraction of a job unemployment compensation represents.

Table 1.
Range of Primary Employment Changes from Economic Development Around the Killingly Industrial Park (# of Employees)

Source of Employment	Frito-Lay A	Combined Changes from Frito-Lay and the Killingly Industrial Park B	C	D	E
Frito-Lay[a]	600	600	600	600	600
Killingly Ind. Park[b]	—	500	600	750	900
TOTAL Primary Employment Change	600	1,100	1,200	1,350	1,500
Unemployment Adjustment[c]	-260	-423	-423	-423	-423
TOTALS (adjusted)	340	677	777	927	1,077

[a]Obtained from engineering estimates of full production by Mr. Bill Ludwig of Frito-Lay.

[b]The planned level of development of the park according to estimates by Mr. Tom Dwyer, the town manager for the town of Killingly, in October 1979.

[c]An unemployment adjustment figure of -423 can be calculated only if 960 unemployed persons are hired.

An unemployment rate of 4% (1240 workers) was chosen to represent "full employment" in the Danielson Market Area and the study area. Subtracting the number of "frictionally" unemployed workers from the present number of unemployed workers will give the number of unemployed workers available to fill the jobs created by the industrial development. It was assumed that the jobs created will first be filled by unemployed workers. It was further assumed that persons presently not in the labor force will not seek jobs from the industrial development. There may be a large amount of movement between firms by presently employed persons. The net number of jobs remaining after these movements between firms are accounted for should be approximately equal to the number of new jobs which were created. It seems reasonable to assume that these jobs will be filled by unemployed persons.

An annual income of $11,290 (Connecticut Labor Department) was used for the new jobs created (W) in making the adjustment for the number of unemployed workers hired.[8] The average annual unemployment compensation for the Danielson Area (C) is presently $4,977.[9] Using these figures and the number of unemployed workers available, 960 persons, the unemployment adjustment figure was calculated and appears in Table 1.[10]

Employment data were collected from the Dun & Bradstreet employment survey by industry for each town in the area.[11] The data were aggregated for 17 industrial sectors according to Standard Industrial Classification (SIC) codes. The employment estimates were then adjusted for the number of firms in each industrial sector who did not report any information. The average firm size for the State of Connecticut was used to adjust the employment data. The average firm size for the State of Connecticut was then multiplied by the number of firms in the NCPR who did not report to determine the adjusted employment estimates of Table 2.

The basic and non-basic levels of employment were determined using the adjusted employment estimates of Table 2. It was assumed that all employment in agriculture is basic to the area. It is normally also assumed that all mining and manufacturing are basic. These assumptions were altered slightly to attempt to more realistically estimate basic employment. For example, in the mining sector a majority of employment represents stone and gravel banks. Such employment often supports local demand. Similarly, bakers (food & kindred), local newspapers (printing and publishing), and local sawmills (furniture, lumber and wood products) often support local demand. Location quotients were used for these sectors and for the transportation; communication and public utilities; wholesale trade; retail trade; finance, insurance and real estate; services; and public administration sectors. The results of the assumption—location quotient method are displayed in Table 2. It would be possible for a person more familiar with the characteristics of the study area to make further adjustments to this approach since employment data from the Dun & Bradstreet files are available at the four digit SIC code level for each town.

The adjusted employment figures of Table 2 were used to estimate basic and non-basic employment by a strict location quotient technique. In using this technique, the agricultural sector no longer indicates any basic employment. The other sectors assumed basic in the previous method were again determined to provide basic activity to the local economy. However, a certain portion of the employment in each sector is allocated to satisfy local demand. Only those sectors in which the area is specialized will show any level of basic or export employment. As shown in Table 2, the basic activity or employment is considerably less than our prior estimate and the non-basic employment is considerably larger.

The basic and non-basic estimates of employment were incorporated into equations (6) and (7) of the economic base model. The estimated employment multipliers for the two methods of determining basic and non-basic employment in the NCPR are 1.62 (assumption-location quotient multiplier) and 2.30 (strict location quotient multiplier). The strict location quotient technique gives a low estimate of basic employment and therefore tends to over-estimate the employment multiplier.

The employment multipliers were then used to calculate the changes in total area employment as described by equations (9) and (10) of the model. To determine the secondary employment changes, the employment multipliers were applied to the adjusted primary employment changes from Table 1. The results are displayed in Tables 3 and 3a for the assumption-location quotient method and the strict location quotient method. It was assumed that all new employment from the changes in industrial activity in the area represent basic employment. This is certainly a valid assumption for the Frito-Lay plant. The plant will supply all the New England States and New York City. The amount of their product consumed in the NCPR is expected to be only a small fraction of the total output. It was assumed that all firms locating within the park will be basic.

The amount of locally supported population per job was calculated. This population multiplier can be applied to the estimated number of in-migrating workers to obtain a gross indication of the population change expected for the NCPR. For this study, the number of in-migrating workers was estimated as the total change in employment minus the number of unemployed workers available (960 unemployed available). The results are displayed in Tables 3 and 3a.

The impacts which are expected to occur within the town of Killingly can be estimated. Survey information is available to allocate changes in employment and population from the NCPR to the town of Killingly.

[8]The average weekly earnings for manufacturing, production, maintenance and related workers was multiplied by 52.

[9]Estimated by the Connecticut Labor Department—Research Department (unpublished statistic-September 1979).

[10]This represents the leakage, in terms of employment, from hiring unemployed workers. For example:
E_u (C/W = 960 (4977/11290)
= 960 (0.44).

[11]This data set was compiled and made available by the Pennsylvania State University. See Table 2 for actual employment data.

Table 2.
Determination of Basic Employment for the Northeastern Connecticut Planning Region

	U.S. Employment (1975)[a] # (000's)	%	Act.[b]	Adj.[c]	*Northeast Region Employment* (Assumption-Location Quotient Approach)[d] Estimated Non-Basic	Estimated Basic	*Northeast Region Employment* (Strict Location Quotient Approach)[e] Estimated Non-Basic	Estimated Basic
Agriculture, forestry and fisheries	3,476	(4.10)	162	200	0	200	200	0
Mining	732	(0.86)	1	16	16	0	16	0
Construction	5,015	(5.91)	493	672	672	0	672	0
Manufacturing:								
Food & kindred	1,843	(2.17)	266	266	266	0	266	0
Textile & apparel	2,245	(2.65)	3,441	3,568	0	3,568	522	3,046
Furniture, lumber, & wood products	1,734	(2.05)	773	800	404	396	404	396
Printing & publishing	1,133	(1.34)	75	157	157	0	157	0
Chemicals & allied	2,804	(3.31)	3,481	3,624	0	3,624	653	2,971
Metal products & machinery	9,092	(10.72)	2,558	3,371	0	3,371	2,114	1,257
Misc. manufacturing	424	(0.50)	416	426	0	426	98	328
Transportation	3,251	(3.83)	225	339	339	0	339	0
Communication and public utilities	2,372	(2.80)	38	50	50	0	50	0
Wholesale trade	3,333	(3.93)	720	802	775	27	775	27
Retail trade	14,137	(16.67)	2,211	2,453	2,453	0	2,453	0
Finance, insurance, and real estate	4,665	(5.50)	78	163	163	0	163	0
Services	23,759	(28.02)	1,408	2,796	2,796	0	2,796	0
Public administration	4,770	(5.62)	15	15	15	0	15	0
Totals	84,785	(100.00)	16,361	19,718	8,106	11,612	11,693	8,025

[a]Source: *Statistical Abstract of the U.S.—1978.*

[b]Actual employment data for the 10 towns in the Northeastern Connecticut Planning Region. Source: *The Northeast Rural Development Data Tape for New England Towns.*

[c]Adjusted at the 4 digit SIC code level by the average size of firms in Connecticut. Source: *The Northeast Rural Development Data Tape for New England Towns.*

[d]The industrial sectors were assumed to be basic (Assumption-Location Quotient Approach).

[e]All sectors utilized location quotients (Strict Location Quotient Approach).

Table 3.
Estimated Changes in Total Employment and Population for the Northeastern Connecticut Planning Region (Assumption–location quotient approach)

	Frito-Lay A	Combined Effects from Frito-Lay and the Killingly Industrial Park B	C	D	E
Basic Employment Change[a]	600	1,100	1,200	1,350	1,500
Total Employment Change[b]	811	1,520	1,682	1,925	2,168
Total Population Change[c]	29	1,602	2,065	2,760	3,455

[a]From Table 1.

[b]Includes: Total primary employment changes (assumed to be all basic) plus the secondary impacts adjusted for unemployed workers hired.

Table 3a.
Estimated Changes in Total Employment and Population for the Northeastern Connecticut Planning Region (Strict location quotient approach)

	Frito-Lay A	Combined Effects from Frito-Lay and the Killingly Industrial Park B	C	D	E
Basic Employment Change[a]	600	1,100	1,200	1,350	1,500
Total Employment Change[b]	1,042	1,980	2,210	2,555	2,900
Total Population Change[c]	235	2,917	3,575	4,562	5,548

[c]For Frito-Lay: 10 management personnel × population multiplier (2.86). All other situations: (Total employment change—960 unemployed workers available × population multiplier (2.86).

SUMMARY AND CONCLUSIONS

The town of Killingly will experience substantial employment changes in the next year. The changes will come about through development of the Killingly Industrial Park and the Frito-Lay plant locating in the township. These employment changes are expected to affect not only the town of Killingly, but also the entire trade area for the economy.

An economic base model was used to develop the employment multiplier and to estimate the total changes in employment. An adjustment was made in the model for the high rate of unemployment in the Killingly area. The major source of data for the study was the Dun & Bradstreet employment survey.

The results indicate significant changes in employment and industrial activity in the NCPR. The most reliable estimate of primary employment changes in the region is that of the Frito-Lay plant. The employment figures obtained were estimated by engineering plans for full production at the plant. The best estimate of total employment changes could be calculated using the multiplier 1.62 and the primary changes associated with only the Frito-Lay plant (600). The estimated total employment change from this impact would be 811 jobs. By including development of the Killingly Industrial Park with the increased employment from the Frito-Lay plant the range of basic employment changes becomes 1100 to 1500 jobs. The actual increase in basic employment will depend upon the level and type of development in the industrial park. Using the employment multiplier of 1.62 the range of total employment changes was 1520 to 2168 jobs. The estimates represent *gross changes* since other changes in the industrial structure of the NCPR can not be anticipated.

There are several implications associated with these estimates. Initially, it was assumed that the full employment level of unemployment was approximately 4%. Economists have recently revised such estimates upward to 4.9%-5.5% (Council of Economic Advisors). If the full employment level of unemployment chosen was to be 5% rather than 4%, the number of unemployed workers available would fall from 960 to 650. In this case, new employment at the Frito-Lay plant will account for nearly all unemployed workers pushing the local economy to full employment. The result will be an increase in the in-migration of workers, increased population and pressure on existing housing markets. This implies further pressure on land-use and zoning regulations in the local economy.

An economic base study can provide information on the *direction* and *magnitude* of *gross changes* in an area's economy from an initial change in basic or export employment. That is the justification in using secondary data for our economic base model of Killingly, Connecticut. Though it is a simplified model of a local economy, it can provide a significant amount of useful information for local officials and planners. Several researchers have found that economic base multipliers provide reliable estimates of Type II I-O multipliers (Garnick 1969 and 1970). It has also been shown that the export base multipliers are mathematically identical to the Type II I-O multipliers and the Keynesian multipliers (Garnick 1970, pp. 36-38; Richardson pp. 49-52).

The economic base model and multipliers are a cost-effective means of measuring the local economy. The model is most appropriate for small rural economies (such as the NCPR), where there is a high degree of specialization (Nelson; Lass and Diamond 1980a). In addition, when the resources and expertise are available, results from an economic base study using secondary sources can be used to help design a survey-based study where primary data are collected.

REFERENCES

Andrews, Richard B., "Economic Planning for Small Areas: An Analytical System," *Land Economics*, 39 (1963):143-155.

Bronfenbrenner, Martin, *Macroeconomic Alternatives*, Arlington Heights, Illinois: AHM Publishing Corporation, 1979.

Connecticut Labor Department, *Connecticut Labor Situation*, Employment Security Division, October 1979.

Council of Economic Advisors, "Measuring and Realizing the Economy's Potential," Readings in *Money, National Income and Stabilization Policy*, ed. Ronald Teigen, Homewood, Illinois: Richard D. Irwin, Inc., 1978.

Garnick, Daniel H., "Dissaggregated Basic-Service Models and Regional Input-Output Models in Multiregional Projections," *Journal of Regional Science*, 9 (1969):36-47.

_____, "Differential Regional Multiplier Models," *Journal of Regional Science*, 10 (1970):87-100.

Hemphill, Margaret and Majorie Murdock, *Social Indicators Profile—WACAP Service Area*, Danielson, Connecticut: Windham Area Community Action Program, Inc., 1977.

Lass, Daniel A. and Joseph Diamond, *A Framework for Conducting An Economic Base Study*, Storrs, Connecticut: University of Connecticut Extension Service, 1980a.

_____, *Estimating Impacts of Industrial Development in Killingly, Connecticut*, Storrs, Connecticut: Storrs Agricultural Experiment Station, 1980b.

Nelson, James R., "An Area Economic Development Impact Model for Extension Application," *Southern Journal of Agricultural Economics*, 10 (1978):89-93.

Northeastern Connecticut Regional Planning Agency, *Transportation Needs*, Brooklyn, Connecticut, June 1976.

Pennsylvania State University, *Northeast Rural Development Data Tape for New England Towns*, University Park, Pennsylvania, November 1978.

Pfouts, Ralph W., ed., *The Techniques of Urban Economic Analysis*, West Trenton, New Jersey: Chandler-Davis Publishing Co., 1960.

Richardson, Harry W., *Input-Output and Regional Economics*, New York, New York: Halsted Press, John Wiley & Sons, 1972.

Tiebout, Charles M., *The Community Economic Base Study*, New York: Committee for Economic Development, December 1962.

U.S. Bureau of the Census, *Statistical Abstract of the U.S.—1978*, 98th Ed., Washington, D.C., 1979.

Weimer, Arthur M. and Homer Hoyt, *Principles of Urban Real Estate*, New York, New York: The Roland Press Co., 1939.