GROWTH POTENTIAL IDENTIFICATION AND PUBLIC INVESTMENT STRATEGY

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Recent federal programs to promote regional economic development stress potential for growth as a criterion for the spatial allocation of federal funds [14]. In Section 504 of the Public Works and Economic Development Act of 1965 each regional commission is encouraged to consider "the relationship of the project or class of projects to overall regional development including its location in an area determined by the State to have a significant potential for growth."

Some persons may object to an area's potential for growth as a criterion for the spatial allocation of public funds. However, this criterion can be justified on the basis of maximizing economic efficiency in the use of public funds. If for a given level of public investment the growth of areas with potential can be increased more than that in areas with less potential, and if the growth in areas with potential provides job opportunities for migrants from areas with less potential, then it is economically efficient for public funds to be allocated to areas with potential [9].

This paper presents an employment projection model to identify areas with growth potential. As an example, it is developed here for eight multi-county areas in Iowa, but the methodology is sufficiently general to be applicable to other areas. The model generates information about change in employment over the projection period for each multi-county area. The distinctive methodological contribution of the model is the inclusion of accessibility to inputs and markets as a measure of potential for growth. The use of accessibility as a measure of potential is suggested by Perloff [12, p. 90] who states that "a region's general access characteristics may be taken as a rough index of its potential for growth."

This study assumes that a mature national economy, such as the United States, functions through the interaction of a network of cities, and that future major economic activity will continue to operate through the network of cities. As the national economy matures, regional differentiation diminishes and urban interaction increases. Therefore, the growth potential of an area depends upon the accessibility of the area, particularly its cities, in the regional and national space-economy.

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The delineation of areas for this study assumes that the urban labor market is a basic factor in the economic organization of space; consequently, the boundaries of the study areas are determined by commuting fields. Fox [8, p. 22] reports "There is conclusive evidence that the American Midwest can be delineated into a set of functional economic areas or commuting fields in terms of the patterns of home-to-work commuting from the peripheries of such areas to the central cities of (usually) 30,000 or more population at their centers."[1] The radius of these functional economic areas is about 50 miles. The areas are identified by the central city in each--Burlington, Cedar Rapids, Davenport, Des Moines, Dubuque, Marshalltown, Ottumwa, and Waterloo. The employment projection model generates information about employment growth for these eight multi-county areas.

Projection Model

The model consists of a demographic sector and an employment sector, as illustrated in Figure 1. The latter focuses on employment opportunities, while the demographic sector focuses on labor availability. The sectors are integrated by migration-employment opportunities linkage. This paper only reports on the projection of employment opportunities.

The employment-sector of the model uses shift analysis to project the commodity-producing employment. This focuses upon three components of change in employment in a given industry i for a given area j:

1. That attributable to overall national growth, the all-industry, all-area growth element, denoted by g_{ij} and referred to as the national effect;

2. That attributable to the overall growth of the industry, over all areas, denoted by k_{ij} and referred to as the industry-mix effect; and

3. That attributable to the competitive performance of industry i in area j, denoted by c_{ij} and referred to as the regional-share effect.

Defining d_{ij} to represent the change in employment between two points in time for industry i of area j, then $g_{ij} + k_{ij} + c_{ij} = d_{ij}$. As an example, consider that $g_{21} = 9$, $k_{21} = 1$, $c_{21} = -8$, so that $d_{21} = 2$.

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[1]The delineation of space into functional economic areas has implications for public policy and planning purposes. As of July 31, 1970, all but 15 states had worked out a system of substate districting [7]. These districts were frequently multi-county areas delineated, in part, by commuting fields.

The second industry of the first area would have increased by nine employees if the industry had grown at the overall national rate that considers all areas and all industries. However, two types of adjustments occurred: an industry-mix effect and a regional-share effect. Because the rate of growth of the second industry over all areas was greater than the national rate of growth, the industry-mix effect increases employment by one. On the other hand, the regional-share effect decreased employment by eight, which indicates that the second industry in the first area grew less rapidly than both the second industry overall and all industries in the nation taken together.

Shift analysis is not new. It has been used by Creamer [5], Dunn [6], Perloff [12, pp. 70-74], and Ashby [1]; criticized by Houston [11] and Brown [3]; and defended by Ashby [2]. It is used in this study as an employment projection technique. Projected national and industry-mix coefficients for 1960 to 1970 and 1970 to 1980 are based on employment estimates by the National Planning Association and take into account shifts in industry demand patterns and technology. The projection of regional-share coefficients is considered in the next section. This step is crucial because each coefficient is unique to a particular industry in each area. The level of industry aggregation and the basis for area delineation are important if the projected regional-share coefficients are to capture the factors relevant to the changing spatial position of the area and future industrial location decisions.

Regression Analysis of Regional-Share Coefficients

A linear multiple regression model is used to identify access factors associated with variations in the regional-share coefficients. This approach derives from the assumption that variations between areas in the regional-share coefficient for a given industry are associated with varying degrees of access to basic inputs and markets. As the national economy has developed, however, interregional differences have diminished. Hoover [10] suggests that as a consequence the selection of plant sites may depend more on the size of place, or the position of the place in the urban hierarchy, and less on regional characteristics of overall access. Three reasons for this shift of emphasis are provided. First, improvements in transportation have reduced the marginal transportation cost of transferring goods, people, services, and information. Second is the increasing importance of urban amenities which are related to increasing affluence. Third is the increased importance of specialization and linkage among industries.

Observations such as those by Hoover suggest a change over time in the inter-industry, or structural, relationships of the economy. The most effective analytical tool for identifying such changes is the inter-temporal analysis of input-output tables. Because each column of the input-output tables provides a description of the inputs used to produce a unit of output for a given industry at a specific time, analysis of changes in the composition of the column over time indicates trends in the industry's input structure. Carter [4] has compared the 1947, 1958, and 1962 national input-output tables.

She concludes that the role of general inputs--energy, services, printing and publishing, packaging, and maintenance construction--has increased. These are inputs that perform similar functions in all types of production.

The independent variables in the regression model attempt to capture these trends in location factors. The model is

$$RSC_{i50-60} = \alpha + \sum_{j=1}^{n} \beta_j (E_j/E.)_{50} + \sum_{j=1}^{n} \gamma_j \Delta(E_j/E.)_{40-50}$$

In this RSC_{i50-60} is the regional-share coefficient for the i^{th} industry between 1950 and 1960, where $i = 1, \ldots m$, the number of commodity-producing industries listed in Appendix A; $(E_j/E.)$ is the proportion of total employment in the j^{th} industry in 1950, where $j = 1, \ldots n$, the number of aggregated industry categories;[2] and $\Delta(E_j/E.)$ is the first difference in the above proportion between 1940 and 1950.

The first set of independent variables (proportion of total employment in each of four aggregated industry categories) is an index of urbanization and captures the economic structure of the area. This represents Hoover's suggestion that the position of a place in the urban hierarchy is receiving greater emphasis as a location factor. If an area has a high proportion of total employment in agriculture, it ranks low in the urban hierarchy. On the other hand, if an area has a high proportion of total employment in focal services, it probably ranks high in the urban hierarchy and can provide the general inputs that, according to Carter, are becoming increasingly important. Also, the area has the services to facilitate a shift from one economic base to another as national demand patterns and technology change. The use of industry specific variables captures the transportation factor by representing inter-industry relationships involving forward and backward linkages.

The second set of variables (first difference or change in the proportion of total employment in each of the four aggregated industry categories) is a proxy for change in access or spatial position. It represents the agglomeration factors, or external economies, associated with increasing urbanization. For example, a positive first difference for manufacturing points to the agglomeration factors associated with increasing urbanization. Thus, it focuses on factors relevant to future industrial location decisions.

Least squares regression analyses were made on six of the twelve commodity-producing industries listed in Appendix A. Agriculture is excluded because the focus of the study is urban-industrial growth potential. The other industries are excluded because their level of employment in Iowa is low. The data are

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[2]There are four aggregated industry categories; agriculture and mining, manufacturing, focal services, and retail trade. Focal services include wholesale trade; finance, insurance and real estate; medical and other professional services; and public administration.

derived from the Census of Population. The observational units are 35 multi-county areas in Iowa that are delineated on the basis of commuting fields.

Selection of independent variables for use in forecasting regional-share coefficients is based upon the following criteria: consistency of its sign with expectations from location theory, low inter-correlation between independent variables, statistical significance at the five percent level, highest possible level of explanation. The regression coefficients for independent variables that entered the model for each industry are given in Table 1.

The positive sign of the regression coefficients for the food and kindred products industry indicates a resource orientation. Food processing plants, such as cattle slaughter plants, are being located away from urban-manufacturing areas and in proximity to the sources of supply. Because processing of milk increases transportability, processors are locating near the sources of supply. Canned and frozen foods also gain in transportability by processing. The development of the highway system, and better refrigerated trucks, generally favor location of plants near the sources of supply. The printing and publishing industry shows an agglomeration orientation as indicated by the positive association with areas experiencing increases in the proportion of total employment in focal services.

The aggregated nature of the industry categories makes difficult further interpretations of the regression analysis and generalization about location factors. Thus, if regression analysis of location factors of industries is to be used effectively, the industries must be disaggregated to a finer level. An example is the work of Spiegelman [13] which uses four-digit industry classifications.

Use of Multivariate Analysis in Employment Projection

Multivariate analysis of industry location factors is used to compute the regional-share coefficients for 1960 to 1970 by area and industry by inserting the appropriate values for the independent variables. The regional-share coefficient, and the national and industry-mix coefficients, are applied to the base-year employment to determine the change in employment between 1960 and 1970 by industry and area. The change in employment in the commodity-producing industries is summed to obtain the total change in commodity-producing employment for each area, which is added to the 1960 commodity-producing employment to obtain 1970 commodity-producing employment.

Non-commodity-producing employment by area is calculated by applying a non-commodity-to-commodity-producing employment ratio to commodity-producing employment. Given non-commodity producing employment, total employment is computed by adding commodity and non-commodity-producing employment. Generally commodity-producing industries are industries whose products compete with those produced outside the area under study. Non-commodity-producing industries are

TABLE 1. Regression Coefficients and Coefficients of Determination

$$RSC_{i\,50-60} = \alpha + \sum_{j=1}^{n} \beta_j \ (E_j/E.)_{50} + \sum_{j=1}^{n} \gamma_j \Delta \ (E_j/E.)_{40-50}$$

Industry	a	b_1	b_2	b_3	b_4	c_1	c_2	c_3	c_4	R^2
Food and kindred products	0.0027 (0.2215)	1.6576* (0.5345)	***	***	***	3.8926 (2.4234)	***	***	***	.27
Lumber, wood product and furniture	-1.1468 (0.4366)	***	***	4.9279* (1.7964)	***	-14.2145* (4.9981)	***	***	***	.36
Printing and publishing	-0.3248 (0.1028)	***	***	***	***	-3.6043** (1.6918)	***	***	***	.30
Chemicals	-3.2012 (0.7962)	***	***	16.8837* (4.1093)	***	***	***	***	***	.34
Electrical and other machinery	-2.7646 (1.0382)	4.2513* (1.4455)	***	10.8236* (3.9270)	***	***	***	***	***	.25
Other and miscellaneous	1.9719 (0.4886)	-3.2693* (0.9755)	-5.0856* (1.4040)	***	***	***	***	***	***	.30

*Indicates that the variable is significant at the 0.01 level

**Indicates that the variable is significant at the 0.05 level

***Indicates that the variable did not enter the model for that particular industry

STANDARD ERRORS ARE IN PARENTHESES

b_1,c_1 agriculture and mining

b_2,c_2 manufacturing

b_3,c_3 focal services which include wholesale trade, finance, insurance, and real estate; medical and other professional services; and public administration

b_4,c_4 retail trade

those industries whose products, or services, are consumed within the areas under study and, therefore, do not compete with firms of the same industry in other regions.

The employment projection model is tested by comparing the 1970 employment estimated generated by the model with employment based upon County Business Patterns data. Data are available from County Business Patterns from 1959 to 1967. It is assumed that employment change occurs during 1968-1969 at the same annual rate that occurred between 1959 to 1967. Data from County Business Patterns are limited by exclusion of self-employed workers.

Table 2 lists the percentage differences between the County Business Patterns data and the model's projection with the percentage difference stated in terms of the County Business Patterns data.

TABLE 2. Test of Employment Projection Model

Multi-county Area	Percent difference
Burlington	- 30
Cedar Rapids	- 10
Davenport	- 9
Des Moines	+ 10
Dubuque	+ 3
Marshalltown	- 5
Ottumwa	- 2
Waterloo	- 1

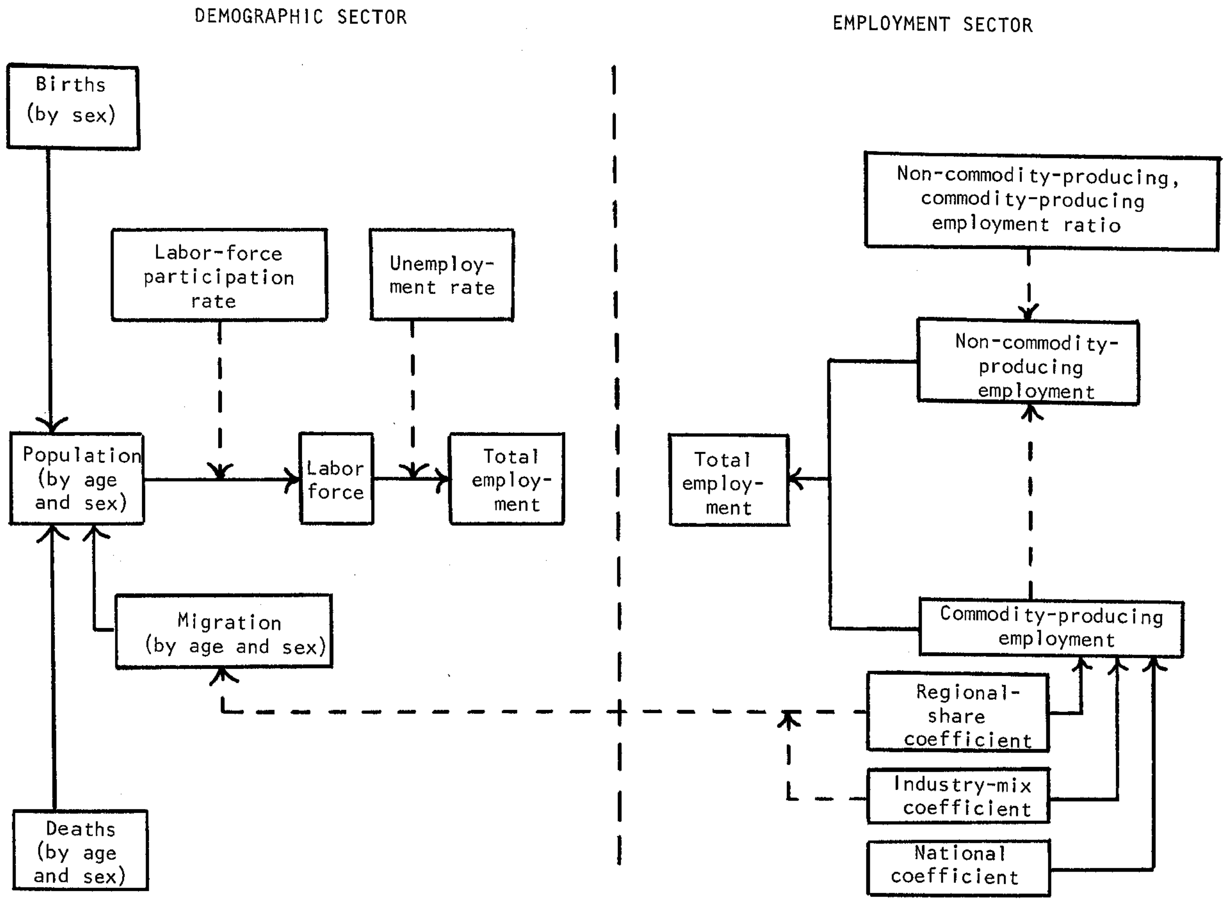
With the exception of Burlington, the employment model yields results that compare closely to County Business Patterns data. The employment growth in Burlington has been unusually high and can be attributed, in part, to the Vietnam War in that a large ordnance firm is located in Burlington.

Use of the Analytical Results

The employment projection model generates information about change in employment by area. High rates of employment change identify areas which have growth potential. This information can assist in deciding the spatial allocation of public funds.

The information also can be used to identify spatial imbalances in the labor market. In Figure 1, the employment sector is related to the demographic sector by the employment opportunity-migration feedback linkage. The demographic sector of the model provides employment projections by generating population projections based on the components-of-change population model--births minus deaths plus net migration. Migration rates are related to an indicator of employment opportunity--the projected industry-mix and regional-share coefficients. Because the regional-share coefficients are projected

FIGURE 1. Demographic-employment Projection Model



for each commodity-producing industry for each area, the migration rates reflect the relative attractiveness of each area. If employment projections generated by the employment sector approach differ from those generated by the demographic sector approach, appropriate manpower strategies are called for to reduce the labor market imbalance.

Future research should take two directions. The analysis of industry location factors needs to be extended to a more-disaggregated industry level to capture distinctive industry characteristics at the four-digit Standard Industrial Classification (SIC) level. Also, as the national economy moves into the Post-Industrial stage, attention needs to be directed to the location factors of the tertiary sector because of its dominant contribution to employment creation.

APPENDIX A

Commodity-Producing Industries and Industrial Classification Numbers

Industry Name	SIC Number
Agriculture	01, 02, 07
Forestry and mining	08, 09
Food and kindred products	20
Textile mill products	22
Apparel	23
Lumber, wood products, furniture	24, 25
Printing and publishing	27
Chemicals and allied products	28
Electrical and other machinery	35, 36
Motor vehicles and equipment	371
Other transportation equipment	37 (except 371)
Other and miscellaneous	19, 21, 26, 29, 30, 31, 32, 33, 34, 38, and 39

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