

# **Proactive Industrial Targeting: An Application of the Analytical Hierarchy Process**

By

Anna M. Cox

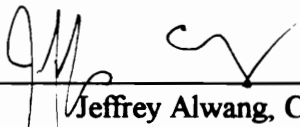
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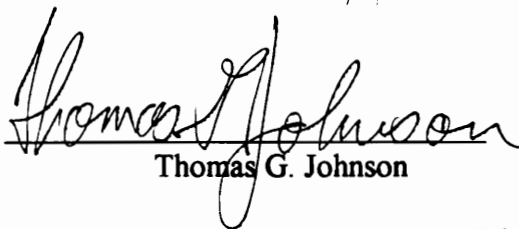
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# INDUSTRIAL TARGETING: AN APPLICATION OF THE ANALYTICAL HIERARCHY PROCESS

by

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(ABSTRACT)

The purpose of this study is to devise a methodology to target industries that would incorporate community preferences in the targeting process. A case-study approach was taken and included three Virginia counties. The most distinctive feature of this research is the use of the Analytical Hierarchy Process (AHP), a method that allows participants to weigh the importance of subjective and objective criteria. Seven firm impacts are used to score the attractiveness of a firm, including economic, public, and environmental impacts. The vector of priority weights obtained from the AHP are applied to the initial score calculated for the impacts of each industry, creating a ranking of preferred industries that are recommended for targeting. From this research it is concluded that community preferences should be an integral part of industrial targeting and economic development in general. State-level policies should be as flexible as possible in order for local level governments to be able to use those policies to attract firms that help that community meet its goals. Rather than focusing energy creating a large number of jobs, community preferences indicate that more effort needs to be spent to attract non-polluting firms that offer higher paying jobs.

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# Chapter 1: Proposal

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## Section 1.1: Introduction

In December 1994 Governor George Allen and over eight hundred contributors helped draft a strategic economic plan for Virginia. Opportunity Virginia: A Strategic Plan for Jobs and Prosperity outlines the economic and job goals of the state, identifies state economic growth strategies, and emphasizes those industries thought to contribute the most to Virginia's economy and future prospects. Included in the plan are several guiding principles for using state incentives to attract and retain firms. Nonetheless, this plan fails to consider community level preferences and goals and does not mention specific criteria or guidelines local development professionals could use to aid them in meeting state and local economic development goals.

Despite the state level programs and strategic plan, local communities, especially the more rural communities, lack the expertise and funding to actively participate in the economic development process described in Opportunity Virginia. Strides are being made, but many communities are still primarily operating with reactive, smoke-stack chasing economic development and incentive policies. In order to successfully compete with other states and localities for migrating or expanding firms, Virginia's communities need to take a more aggressive, proactive view of firm recruitment and retention.

This study provides a framework that local communities can use to develop an industrial targeting policy that incorporates community leaders' preferences<sup>1</sup> in the targeting

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<sup>1</sup> For this research community leaders' preferences are assumed to reflect the preferences of the community as a whole and is therefore frequently referred to simply as community preferences. It is recognized that this assumption is not always be true.

process. First, industries having a large potential impact on a locality are identified. Second, the value that community leaders place on several social, environmental, and economic impacts are determined. These preferences are then used to evaluate each industry. Those industries having more of the most desirable impacts are the industries that should be targeted for expansion, retention, or recruitment. Finally, incentive policies are recommended that would better address the needs of the community and industry.

### **Section 1.2: Problem Statement**

In general, rural communities lack the expertise and funding that are required to develop an economic development plan that incorporates community preferences in an industrial targeting scheme.

### **Section 1.3: Objectives**

1. Determine the industries that will have the largest potential local economic impact, including those industries that are not yet present in each community.
2. Estimate relative community preferences for impacts (economic and non-economic) likely to result from successfully attracting a relocating or expanding firm.
3. Score firms according to their impact levels so that each industry can be evaluated using the weights that the community places on each impact.
4. Identify industries that rank the highest.
5. Discuss policy options that might enhance the ability of a community to recruit desired firms.

### **Section 1.4: Justification**

In order to implement a proactive targeting program, communities must first determine firm characteristics and the impacts each firm type would have locally. Decision-

makers must also determine the value they place on one impact relative to another. If an industry is found to be desirable, incentive policies should be structured to target such an industry. If such a strategy were followed a community would have a greater chance of achieving its local economic development goals.

### **Section 1.5: Summary of Methods**

1. Identify industries having the largest potential impacts using input-output.
2. Determine local preferences for different firm impacts using the Analytical Hierarchy Process.
3. Create a scoring method for each of the identified impacts.
4. Match preferences with economic impacts to prioritize firms.
5. Analyze incentive policies in order to make policy recommendations.

### **Section 1.6: Layout of Thesis**

Chapter 2 describes some of the historical economic development practices and strategies and of each of the case-study areas. The chapter begins by characterizing some of the methods and incentives that have been used to recruit firms in the past, eventually leading to the current ideas. The chapter then gives examples of the Virginia state policies that reflect the changes described in the literature. The second part of Chapter 2 gives an overview of some of the economic and socio-economic characteristics of the case-study areas.

Chapter 3 describes the methods used in the study. The first several sections characterize industrial targeting and several of the tools that have traditionally been used to target industries. The second set of topics discuss input-output and IMPLAN, and then

specifically shows the steps used to include sectors in the study for which no county-level data are available. The third set of sections explains why and how community preferences will be included in the study. The last several sections specify how industry impacts will be measured and scored, with the final section describing how the community preferences are included in the targeting process.

The results of the research are included in Chapter 4. The priority rankings for each case-study area are displayed. The final industry rankings, which have incorporated community priorities, are also displayed. The industries with the biggest adjusted scores are those that are recommended for targeting.

The policy implications of this research are discussed in Chapter 5. Also included in the final chapter are the areas of research that should be addressed in the future. Finally, the strengths of this research, as well as the areas that need improvement, are described.

## **Chapter 2: Background**

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### **Section 2.1: Introduction**

This chapter is divided into two main sections. The first section discusses the main economic development strategies used over the past several decades. It also includes examples of Virginia policies that involve these development strategies. The second section provides an overview of the three counties that are case-study areas in this research.

### **Section 2.2: Economic Development Strategies and Virginia**

Government officials have tried to attract industry to specific areas for over one hundred years. In the late 1800s firms encouraged local politicians to keep tax rates low in order to maintain an attractive climate for industry. These low rates decreased local revenues that could be used to fund education and public services, but were considered necessary to support businesses. Keeping a pro-business climate through low business taxes is still a large part of most states' economic development policy mix. Making a state's business climate more attractive is the dominant indirect method of attracting industry (Isserman, 1994). In order to have a "good" business climate, it is thought that a state must take measures to keep down the cost of doing business. Business climate is thought to be enhanced by low tax rates, low unemployment costs, low disability compensation costs, few regulations, and low labor costs (Isserman, 1994).

Many of Virginia's current policies are still aimed at keeping the state a low-cost business environment. Virginia's corporate income tax rate of 6% and state and local sales and use tax rate of 4.5% are among the lowest in the nation (Commonwealth of Virginia, 1994b). Opportunity Virginia outlines regulatory reform, the purpose of which is to streamline or eliminate regulations or permitting processes that may be costly to business. Another example of the move towards a more favorable business climate is Virginia's changing of the Business, Professional and Occupational Licensing Tax (a tax levied at the option of a locality based on gross receipts during the previous tax year) over the next several years. There are also plans to review other possible tax reforms (Allen and Skunda, 1994).

In addition, Virginia has the lowest worker's compensation tax rate and the third lowest unemployment insurance costs among all fifty states (Commonwealth of Virginia, 1994b).<sup>1</sup> The fact that Virginia is the northern-most state having a right-to-work law is presented in Opportunity Virginia as one of the state's key competitive advantages (1994). Policies that reduce costs to firms are implemented to help make Virginia attractive to industry and competitive with neighboring states.

The idea that the *active* promotion of business location and expansion to specific areas was a legitimate role of the government became widely accepted

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<sup>1</sup> Based on 1992 data.



after World War II. The Great Depression had already led to increased government involvement in many areas of the economy. It took very little to extend this level of interference beyond “propaganda and hard sell” techniques, despite the fact that subsidies and give-away programs aimed at private businesses were illegal in most states (Cobb, 1982).

States are said to be “chasing<sup>2</sup>” or recruiting industry when they attempt to increase employment and income in their area by seeking investment from sources outside the local community (Isserman, 1994). State and local governments, mostly in the Southern United States, began to use direct financial incentives in the 1930s as a way to induce industries to locate to their state or area. By offsetting some of the costs of doing business, rural areas could better compete with more industrialized areas for migrating or expanding industries. By the 1980s almost every state had an economic development policy that provided financial incentives to companies relocating to their area.

The financial incentives policies in any state may include loans, grants, subsidized interest rates, free or reduced cost of land, buildings, and machinery, subsidized worker training, subsidized or negotiated water, electricity, and sewer rates, and property tax reduction or forgiveness. Virginia offers a full range of financial

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<sup>2</sup> Historically, incentives were only used to attract manufacturing firms, hence the commonly-used term was “smokestack-chasing”. More recently, other firm types, including service and professional firms, have become more amenable to relocating so the term “chasing” is used.

incentives. State incentives include loans, income tax refunds, and worker training programs. Local governments also have the authority in Virginia to grant concessions to relocating and expanding industry. Common local incentives include subsidized land, subsidized building construction, and reduced water, electricity and sewer rates.

Firm recruitment policies have historically been viewed as being very successful. When Mississippi officials began offering financial inducements in 1935 they successfully attracted twelve large manufacturing firms in a four-year period (Isserman, 1994). There have been recent examples of states attracting large manufacturers with their incentive packages, such as Alabama's incentive package attracting the Mercedes-Benz AG's automobile plant and Kentucky's incentive package attracting the Canadian steelmaker, Dofasco, Inc. (Shelton, 1994). In 1994 Virginia was ranked the eighth most successful state in attracting industry by Site Selection magazine (Sturgeon, 1995).

However, these successes came at a cost. The per-job cost<sup>3</sup> is often the measure by which a locality is considered to have made a good deal or "gave away the farm" when offering an incentive package to a firm (Shelton, 1994). Alabama was successful in attracting the Mercedes-Benz plant, but at a cost of \$220,000 per-job. Kentucky's per-job cost exceeded Alabama's, giving incentives to Dofasco Inc. totaling \$350,000 per-job (Shelton, 1994). Even Virginia has not stayed out of the bidding war to attract and keep

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<sup>3</sup> The per-job cost is calculated by taking the total discounted value of the incentive package over time divided by the number of jobs. The value of the incentives includes grant values and the cost of subsidizing loans.

companies. The Roanoke Times and World News reported, in June 1995, the amount of incentives given to firms in 1994. The highest per-job cost in Virginia was over \$171,000 given to a Volvo GM Heavy Truck plant (Sturgeon, 1995). Not all incentive packages are so generous, but these large public transfers to the private sector have occurred often enough to make many academics and the public question the wisdom of incentive policies.

Just looking at the per-job cost ignores many of the factors community leaders consider in the decision-making process. The future flow of tax revenues is one such consideration. Leaders may be trying to position the community as a place where business is welcome. Also, attracting a large basic industry in the future may act as a magnet to attract other, related industries. These are just three items community leaders may consider in their decision-making process. People criticizing of large incentive packages need to look further than just the per-job cost.

Critics argue that the types of industries that are heavily influenced by incentives to relocate are firms that generally tend to pay lower wages (Cobb, 1982; Ross and Friedman, 1990). While creating jobs in an area is one of the main economic goals of most local officials, particularly politicians, the quality and pay of those jobs are increasingly being granted more importance by community members. Even if a firm offering high wages relocates to a locality, there is evidence suggesting relocating firms contribute relatively few new jobs to the local workforce (Eisinger, 1988). In-migration and commuters from nearby areas decrease the benefits of a new firm to local residents.

In fact, for relocating firms, “on average, four out of five new jobs in a local economy will go to people who otherwise would have lived elsewhere” (Bartik, 1995, p. 3).

Many critics also consider recruiting firms by offering financial incentives a zero sum game. The relocating firm’s employment, income and tax contributions to local economies are simply being shifted from one community to another. The gain to the community successful in attracting an industry is offset by the loss felt by the community from where the industry moved. It is only when the region being considered is smaller than the nation, and when the industry in question is considering migrating abroad, that a zero sum does not result.

Finally, critics cite evidence that incentive packages have little impact on a firm’s location decision. Many executives listed financial inducements low on a list of factors used when making a location decision (McSweeney, 1994). If the incentive package was considered important by the firm, it was usually only during the final stages of the relocation decision-making process as a tie breaker between competing locations, a fact that often brings about a “bidding war” between competing localities (Cobb, 1982; McSweeney, 1994). However, proponents of incentives reason that one would not expect incentives to be the first characteristic a firm would look for in a community, other characteristics such as the labor pool are much more important. Considering incentive offers from localities later in the decision making process does not necessarily minimize the importance of incentives to the firm.

The fact remains that incentives could be useful. There are theoretical reasons why a community might subsidize firm location. A community might recruit firms that would help them capture agglomeration effects. There also might be opportunities for economies of scale to exist if a particular industry in a locality were induced to expand production. Localities dependent on a few industries might try to increase the number and diversity of industries in their area in order to create a more stable economy. Finally, using incentives is a way for communities to address certain kinds of market failure. For example, structural market failure occurs when there is imperfect information, immobility of capital or labor, and externalities. These factors might be the cause a misallocation of capital and labor among places and uses (Shaffer, 1989). Another kind of market failure, performance market failure, occurs when the market yields results that are not socially optimal, which is the case if residents feel there is a poor distribution of wealth in the community (Shaffer, 1989). Still, the criticisms, considered in conjunction with existing firms' resentment over the incentives offered to relocating firms, instigated the consideration of other development options.

The development efforts of the 1980s focused on “‘homegrown’ or indigenous economic development activity” (Ross and Friedman, 1990, p. 4). The expansion and retention of existing industry was considered to be a way of assisting lagging rural economies without facing many of the same criticisms of the previous development efforts. Enhancing export-based industries, those industries that make the majority of their sales outside the local region thereby bringing outside dollars into the locality, were

particularly emphasized. State and local governments also became involved in targeting specific industries and firms (relocating and indigenous firms) for development, instead of offering incentives to any firm that indicated an interest in relocating to their area. The term “entrepreneurial development” is often used to express the type of involvement government started taking in the market (Eisinger, 1988; Leicht and Jenkins, 1994).

“Self improvement” efforts were also taking place during the 1980s (Isserman, 1994). States created programs to target small businesses, provide venture capital funds, provide vocational training programs, and build large-scale infrastructure (Isserman, 1994). The overall goals of the programs were to ensure that local resources, a skilled workforce, available technology, modern telecommunications, and adequate infrastructure were made available to industry. Government realized that “cost is no longer the strongest magnet for new investment--rather it is an economic environment rich with the human, technological, financial and infrastructure resources that support existing firms and entrepreneurship” (Ross and Friedman, 1990, p. 5).

Virginia has kept pace with the trend in development by creating many of the programs that were suggested in the 1980s. An incentive program was recently created that targets manufacturers of solar photovoltaic panels. There are also several incentives programs only available to firms locating in a specific region. Self improvement strategies are represented in Virginia’s policy mix. Vocational training programs have been created, although on a rather limited scale. Infrastructure funding has become a large part of many state-level incentive programs. The Governor’s Opportunity Fund is

one of the most popular incentive policies for infrastructure and site improvements. Two other infrastructure financing programs include the Road Access Program and the Industrial Rail Access Program.

Adoption of these strategies did not halt the use of direct financial incentives offered to relocating business. Instead, these new strategies helped communities in their recruitment efforts because more research went into finding the firms that desired the attributes a community had to offer. While these policies still induce firms to relocate, expand, or start a new business in a certain location by lowering costs, there are long-term benefits associated with having better infrastructure and a highly skilled workforce. That is, if a recruited firm were to leave, the investments in infrastructure or the skills obtained by the labor force do not leave with the firms.

Despite the improvement over granting direct financial incentives, an economic downturn occurring in 1988-89 led states to start questioning the effectiveness of these self-improvement strategies (Isserman, 1994). Budget problems forced states and localities to examine their various economic development programs. Studies showed that the various programs had little lasting impact on the well-being of the economy (Isserman, 1994; Ross and Friedman, 1990). The lack of impact was caused by several factors, including a lack of program scale, a fragmentation of the services and programs offered, and a lack of accountability of the programs to community residents. Ross and Friedman give examples (p 5-6, 1990): “One program helps train workers, but is out of touch with the latest technology applications. Another helps identify practical ways to

apply new technology, but disclaims any knowledge or responsibility for capital availability to finance new equipment.” In retrospect, it was determined that these self-improvement tools were being implemented with the same lack of long-term planning as were the direct chasing strategies.

The realization that government could not afford to indefinitely fulfill functions usually left up to the market led to the most recent economic development efforts. Referred to as the “Third Wave<sup>4</sup>,” the recent efforts focus more on how things are done, rather than what things are done (Isserman, 1994). This is a change in *philosophy* rather than a new *method* of economic development. Government officials started engaging in strategic planning in an effort to “develop a new understanding of strengths, weaknesses, opportunities, threats, objectives, and directions” (Isserman, 1994, p. 83). Instead of creating more programs, government leaders are trying to create new organizational approaches that will help fill identified gaps. The first two development strategies have government as the sole supplier of services needed to fill the gaps in a community. Governments following Third Wave principles focus more on creating a cohesive set of programs and try to “engage other public and private institutions in meeting developing needs (Ross and Friedman, 1990, p. 7).

Governments are also trying to make sure that the money they spend to fill identified gaps is having impacts that are valued by the intended beneficiaries. No longer is there the notion of development no matter the cost. Community preferences are

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<sup>4</sup> The Corporation for Enterprise Development and Doug Ross are primarily responsible for the term “Third Wave” that is used to represent the most recent efforts in economic development (Isserman, 1994).



starting to play a larger role in the development process. The desirability of a project can be verified by having the beneficiaries invest their own time or resources in the project (Ross and Friedman, 1990). Rating the worth of a project and its impacts by the amount of citizen involvement and the amount of locally funded incentives places the economic development burden more on local-level government. Because local government has a closer link to the residents of a community, commitment of local time and money to a project gives an indication of the desirability of that project.

Strides are also being made at the state level. Many states have a strategic plan that identifies strengths, weaknesses, and opportunities. Benchmarks are being formed by which policies and policy results can be measured. New institutions are being created to help address local problems. For example, in Virginia, Governor Allen created eighteen regional rural commissions to encourage more regional strategic marketing and planning and to help link local planning to the goals of the state. In addition, several of Virginia's incentive policies now have a matching fund criterion that must be met by local governments or the private sector in order to receive the state incentive money.

Despite the changes at the state level, many rural communities have not been able to effectively incorporate Third Wave strategies. State governments lack close ties to the communities that are targeted for development, while local-level governments lack the funds and expertise to successfully practice Third Wave development strategies. One way for rural communities to become more effective is to develop an industrial targeting plan that would incorporate community preferences. Incentives should be used to attract,

retain, and expand those firms whose impacts help local residents the most in achieving local goals. In a time when budget cutbacks are the norm, communities can not afford to use incentives indiscriminately.

### **Section 2.3: Case Study Areas Profiles**

Three Virginia counties were chosen as case study sites for this research: Bath County, Montgomery County, and Halifax County. Each county is located in a different region of Virginia and has different social and economic characteristics.

Bath County is located in the Allegheny Highlands and has a land area of 531.9 square miles. The main towns are Hot Springs, Warm Springs, and Millboro. The county's industrial park is located in Millboro. This park has the capacity to hold two or three smaller manufacturing firms. Becova Guild, a manufacturer of light textiles, was the previous sole occupant in the industrial park, but is in the process of relocating to a new site in Allegheny County, leaving its building unoccupied. There are no other structures in the park. The main transportation routes are Highway 220, Highway 42, and Virginia By-way 39. These are two lane highways that wind through the mountains. The nearest interstate highways are Interstate 64, approximately 25 miles to the south of Hot Springs, accessed by Highway 220, and Interstate 81, approximately 30 miles to the east of Millboro, accessed by Virginia By-way 39. Rail transportation is available and tracks pass near the industrial park.

Montgomery County is part of the New River Valley, located between the Appalachia and Blue Ridge Mountains and has a land area of 388.2 square miles. The

main towns are Blacksburg, Christiansburg, Elliston, and McCoy. There are several industrial parks located throughout the county, including the Blacksburg Industrial Park, the Christiansburg Industrial Park, the Elliston-Lafayette Industrial Park, and the Corporate Research Center, which is located in Blacksburg and managed by Virginia Tech. There are several publicly owned sites and buildings suitable for occupation, as well as privately owned facilities throughout the county. Each of these facilities has easy access to Interstate 81. Highway 460 is the other main transportation thoroughfare, running east-west. Rail transportation is also available in the county.

Halifax County borders North Carolina in the relatively flat piedmont region, with a land area of 813.8 square miles. South Boston, an independent city located in the center of the county, is the largest town and the site at which most of the industry in the county is located.<sup>5</sup> The other larger towns are Halifax, the county seat, Clover, and Scottsburg. There are three main transportation highways in the county. Highway 58, running east-west, and Highway 360, running northeast-southwest, are both multi-lane highways. Highway 501, running north-south, is a two-lane highway. There are two rail transportation options in the county, both tracks pass through South Boston.

Not only are these three counties geographically diverse, there are also many differences in their socio-economic characteristics. Bath County is the most rural of the case study areas, with a population density of only 8.9 persons per square mile. Halifax County's population density, including South Boston, is 35.1 persons per square mile.

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<sup>5</sup> Because of South Boston's prominence in the county, all data and discussion for Halifax County includes South Boston.

Montgomery County has a population density of 192.2 persons per square mile. Of the three counties, Montgomery County is the only one whose population is projected to increase, growing 12.5 percent by the year 2005 (Table 2-1). Bath and Halifax counties are expected to lose 5.4 percent and 4.2 percent of their population, respectively, by the year 2005 (Weldon Cooper Center for Public Services, 1994).

There are wide differences in each county's poverty, unemployment, and average educational levels (Table 2-2). Unemployment in each county is above that of the state as a whole. Bath County has unemployment of 16.1 percent, while Montgomery and Halifax counties have approximately 8 percent unemployment in 1992. Looking at each socio-economic variable included in Table 2-2 simultaneously, it would seem that Montgomery County is the worst off of the three, having the highest percentage of people below the poverty line, and the lowest average per capita income. However, included in the Montgomery County data are the 22,000 students attending Virginia Polytechnic Institute and State University, many of whom only have part time jobs and who receive the majority of their income from parents or from sources outside the county. Therefore the inclusion of college students skews the results, making Montgomery County residents appear worse off than they actually are.

Halifax County is perhaps facing the most difficulties, having low average incomes, a high percentage of people below the poverty line, and a high school graduation rate of only 51.8 percent. Bath County has the highest unemployment rate of the three counties, but because of its smaller population, a small increase in the number of

**Table 2-1: Population Projections for the Three Case Study Counties**

<b>County</b>	<b>1992<sup>a</sup></b>	<b>1995 (projected)<sup>b</sup></b>	<b>2000 (projected)<sup>b</sup></b>	<b>2005 (projected)<sup>b</sup></b>
<b>Bath</b>	4,759	4,646	4,501	4,500
<b>Montgomery</b>	74,606	79,604	81,760	83,915
<b>Halifax</b>	36,441	35,603	35,196	34,894

<sup>a</sup> Bureau of Economic Analysis.

<sup>b</sup> Weldon Cooper Center for Public Services.

**Table 2-2: Socio-Economic Characteristics for Virginia and the Three Case Study Counties**

	<b>Virginia</b>	<b>Bath</b>	<b>Montgomery</b>	<b>Halifax</b>
<b>Number of People in the Labor Force<sup>a</sup></b>	3,359,000	1,999	36,649	19,053
<b>Unemployment Rate<sup>a</sup></b>	6.4%	16.1%	8.3%	8.0%
<b>Average Income<sup>b</sup></b>	\$21,653	\$19,855	\$14,195	\$14,735
<b>Percentage of People below the Poverty Line<sup>c</sup></b>	10.2%	14.2%	22.1%	16.7%
<b>High School Graduation Rate<sup>d</sup></b>	75.4%	68%	74%	51.8%

<sup>a</sup> 1994-95 Virginia Statistical Abstract, 1992 data.

<sup>b</sup> Bureau of Economic Analysis, 1993 data.

<sup>c</sup> 1994-95 Virginia Statistical Abstract, 1989 data.

<sup>d</sup> 1994-95 Virginia Statistical Abstract, 1990 data.

jobs would have a large impact on the area. The residents of Bath have an average income 92 percent of that of the state as a whole. There is a gap between the rich and poor people in the county as can be observed by the greater than average percentage of people in Bath County living below the poverty line.

The economic structure of each county is different from the others (Table 2-3). Almost half of the people employed in Bath County work in services. Bath County's dependence on tourism accounts for its heavy reliance on the service industry. The Homestead, a resort located in Bath County, is one of the major employers. There are a substantial number of bed and breakfast establishments to meet the demands of tourists. Twenty percent of the employment in Bath is in manufacturing. With Becova Guild moving to Allegheny County, the percentage of people employed in manufacturing will be lower, although many of the employees have chosen to commute to Allegheny County, rather than face unemployment or move. The other thing to note about Bath County is the relatively small retail sector that it has. Other than the shops that are a part of the Homestead, there are few retail outlets in Bath County.

The retail sector is the largest in Montgomery County, with the manufacturing and services sectors being the second and third, respectively. The prominence of the retail sector may be due the large number of college students in the area. Montgomery County is a trade center for a large area of Southwestern Virginia. The manufacturing sector accounts for a larger portion of employment than for the state of Virginia as a whole. The

**Table 2-3: Economic Reliance on Sectors by Virginia and Three Case Study Counties By Percent of Total Employment,<sup>a</sup> 1993**

	<b>Virginia</b>	<b>Bath</b>	<b>Montgomery</b>	<b>Halifax</b>
<b>Agricultural services, forestry, fishing, and mining</b>	1.4	0.6	1.2	1.1
<b>Construction</b>	6.1	4.7	4.4	5.5
<b>Manufacturing</b>	17.3	21.0	28.0	49.2
<b>Transportation</b>	5.8	12.7	1.6	3.5
<b>Wholesale</b>	5.5	0.7	2.3	3.0
<b>Retail</b>	21.9	9.5	35.1	19.0
<b>Finance, insurance, real estate</b>	6.8	1.6	4.7	1.1
<b>Services</b>	35.1	49.3	22.7	17.6
<b>Unclassified</b>	0.1	0.0	0.0	0.0

<sup>a</sup> 1993 County Business Patterns, excludes most government employees, railroad employees, and self-employed persons



services sector, while representing 23 percent of the employment in the county, is substantially smaller than the state average of 35 percent.

Manufacturing is the largest source of employment in Halifax County, accounting for about half of total employment. The retail sector is a distant second with 19 percent of the employment of the county. The services sector employs 17 percent of work force. The retail and services sectors are far below the state levels. Also, it should be noted that the majority of the employment in Halifax County, no matter the sector, comes from firms and business located in South Boston.

Each of the case study areas has different geographic, social, and economic characteristics. Bath County is the most rural, with a high dependence on tourism. Montgomery County is the most diversified of the three counties considered. Halifax County has the largest reliance on manufacturing, with most of the industry centered around South Boston. Despite the differences, the guidelines presented throughout this thesis are applicable to each area. The tools used will help each of these communities target the specific industries that best reflect the preferences of the community.

## Chapter 3: Methods

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### Section 3.1: Introduction

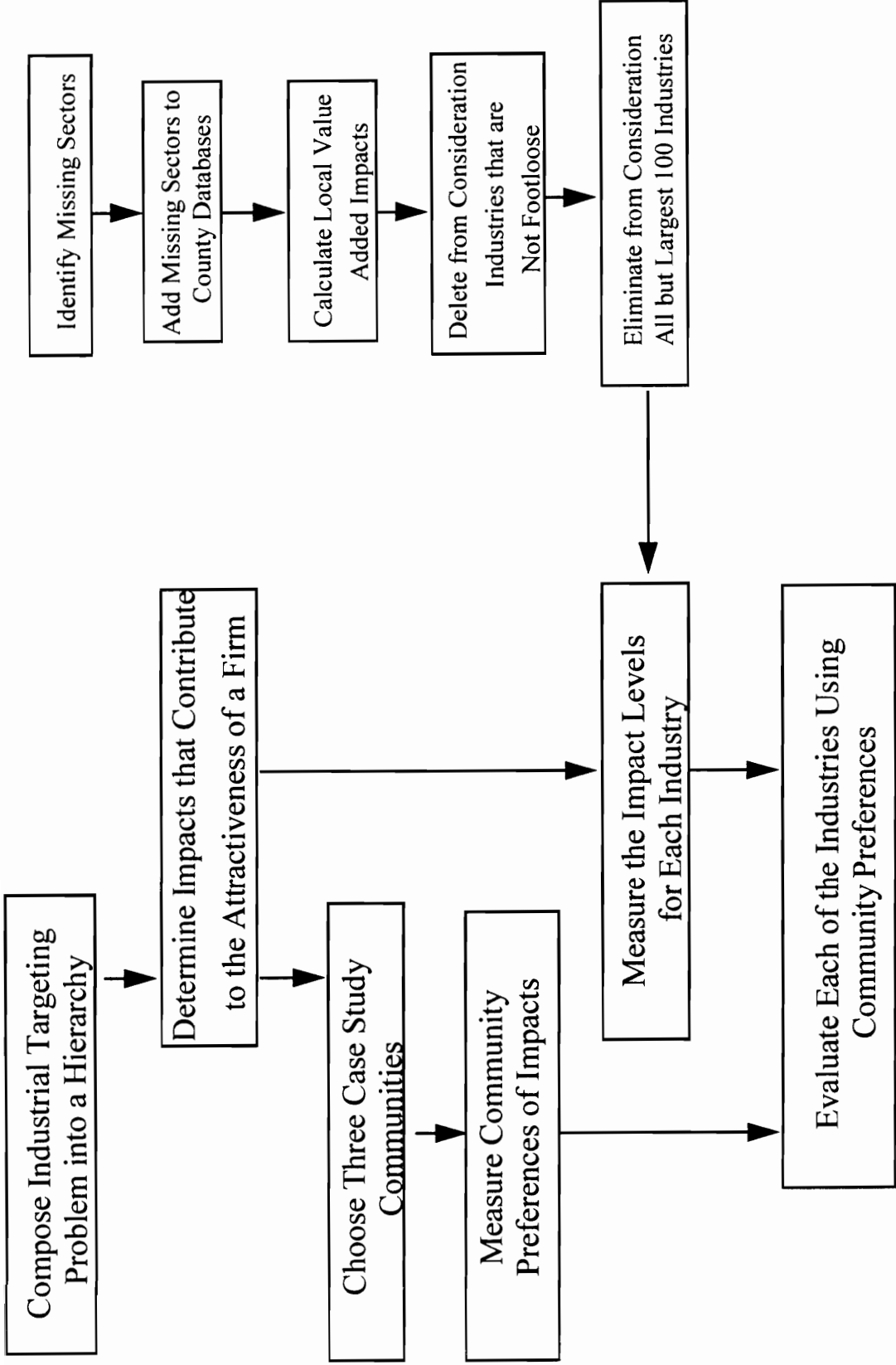
There are several questions a community must answer during the industrial targeting process: “Will an industry come?”, “What is the probable impact of that industry were it to locate in the community?” and “Does the community want that industry?” There are models available to help a community answer the first question.<sup>1</sup> The present research primarily addresses the final two questions. Figure 3-1 provides a schematic of the steps used in this research.

The first step of the research uses state data to identify sectors missing at the local level. These sectors are added to each county’s IMPLAN database in order for local impacts to be calculated. Industries considered to be factor-dependent or market-oriented (i.e. less likely to be footloose) are the only ones eliminated at the start of the targeting process, primarily because of the low likelihood that firms in these industries can be influenced to relocate to any area. The economic impact, as measured by the value-added effect, an industry would have on the community is the screening variable used to identify an initial set of one hundred industries for targeting.

Concurrently, the Analytical Hierarchy Process is used to decompose the industrial targeting problem into a hierarchy. Several impacts a firm might have on a community are identified as being possible factors affecting community leaders’ consideration of a firm’s attractiveness. Using pairwise comparisons, the importance of

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<sup>1</sup> The NEEDS Model, mentioned later, is one such model.



**Figure 3-1: Overview of Steps for This Research**

the previously identified impacts are obtained from community leaders. The final step in this research is to use the community preferences to evaluate the 100 sectors identified first identified.

### **Section 3.2: Industrial Targeting**

Traditional industrial targeting efforts use a variety of methods to identify industries. Many communities produce brochures listing community attributes and mail them to highly visible firms. The community members assume (or hope) that characteristics unique to their area will catch the attention of the person in charge of location decisions. Many communities advertise in Site Selection or other similar magazine, which focus exclusively on industrial location issues. Some regions go beyond this and take out advertisements in mainstream magazines, such as Pennsylvania did when it ran a nineteen page advertisement in the December 25, 1995 issue of Fortune Magazine. The World Wide Web is also becoming a popular and inexpensive way to advertise. However, these direct advertising methods would be more effective if more effort could be concentrated on a fewer number of industries that have been selected because they meet certain criteria (Shaffer, 1989). There are several methods being used in industrial targeting studies that attempt to narrow the field of possibilities for communities.

### Section 3.3: Traditional Tools Used for Industrial Targeting

Location quotient (LQ) analysis is one of the most popular methods used to target industries (Akpaddock, 1992). The LQ measures the degree of concentration, using employment data, of a given industrial sector in a locality as compared with the state or national concentration of that sector.<sup>2</sup> The assumption is that a locality that is highly specialized in a certain sector is exporting that good or service. A sector having a location quotient greater than one is categorized as a basic (export) sector, while a sector having a location quotient less than one is categorized as a non-basic (import) sector. This categorization identifies those sectors that should be targeted if the community wishes to follow either an export-base enhancement strategy or an import substitution strategy.

The use of location quotients generally represents a first attempt at narrowing the number of industries that a community might target for expansion. Other “first attempts” include such things as trade area analysis or shift-share analysis. Trade area analysis uses sales data to calculate such things as a sector’s potential sales, pull factor, and leakage or surplus (Shaffer, 1989; Hustedde, Shaffer, and Pulver, 1993; Cox and Alwang, 1996). Trade area analysis is used more often for analysis of the retail sector, although it can also be used to analyze the industrial sector. The pull factor is interpreted much like the location quotient: a pull factor greater than one indicates an export sector and a pull

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<sup>2</sup> Location quotient for sector  $i = \% \text{ local employment for sector } i / \% \text{ national employment in sector } i$ .

factor less than one indicates an import sector. The potential sales and leakage/surplus figures then represent the impact that might occur if that sector became self-sufficient.

Shift-share analysis does not identify exporting or importing sectors, instead it looks at changes in a sector employment over time (Hustedde, Shaffer, and Pulver, 1993). Shift-share is a descriptive technique that attributes change in employment to three forces. The first cause of employment changes is the local change as stimulated by a national change (i.e. overall national growth/decline). The second cause of change is attributed to a local concentration of business in relatively high-growth sectors. Change coming from having more competitive (meaning a local sector has been more successful in securing additional employees than the same sector has been for the nation as a whole) firms locally is the third cause of change. These three forces are generally titled national growth component, industrial mix component, and competitive share component, respectively (Hustedde, Shaffer, and Pulver, 1993).

These three types of analysis should be used in conjunction with other screening tools. The need for more than one type of analysis arises because of weaknesses of each of the measures. First, they are ratios that compare a smaller region with a larger region (often the entire country). An implicit assumption of each measure is that the locality should be striving towards the larger region's level and mix of industry, thereby ignoring a region's possible areas of competitive advantage due to specialization or unique community characteristics.

Second, each of these tools give only one view of the economy, either as import or export in the case of location quotient analysis and trade area analysis, or as attributing change to very aggregate national and local factors. Third, each of these tools ignore, to some extent, variations in tastes and preferences, different marginal propensities to consume locally, different economies of size, and different production practices and technologies (Shaffer, 1989). The strong assumptions and limited scope of location quotient analysis, trade area analysis, and shift-share analysis make them best suited as an initial step in the targeting process. Consideration of the economic structure of a region and the goals of a community need to be incorporated into the industrial targeting process.

Industrial targeting has also been looked at from the point of view of the public sector. Cost-benefit analysis is a popular method of determining the advisability of granting a firm an incentive package (Shaffer, 1989). The public costs associated with an incentive package are generally evident. However, the full impact, or net benefit, a firm has on the local economy is less clear because of possible externalities and hidden costs. The variability in how a project's benefits and costs are measured is the largest potential weakness of cost-benefit analysis. Another weakness in this type of analysis is that the cost-benefit study is usually conducted *ex post* the firm relocation or expansion, though it is possible to do the analysis before hand. The cost and time requirements of the analysis itself are also barriers to fully implementing cost-benefit analysis as a targeting tool, especially as a proactive method.

There is an industrial targeting model developed for regions in Virginia and other northeastern states. The Northeast Industrial Targeting and Economic Development (NEEDS) Model was developed to help rural communities target those industries that are more likely to locate in their community. This model identifies community attributes that are statistically related to plant locations (Goode, 1993). The model then identifies the industries that have a higher probability of locating in each locality.

The NEEDS model also has weaknesses. One of its weaknesses is the highly aggregated nature of the industries included in the database. Also, only heavy manufacturing industries are included in the sixty-nine industries in the model. Light manufacturing and non-manufacturing industries, many of which may have large positive local impacts, are not included. Next, the model fails to consider such things as the footloose nature of the industries. The model also does not calculate any of the impacts that would occur if an industry were to relocate to a particular area. Finally, the data the model are based on is outdated. The model was completed in 1986 and was based on data from 1969-1978 (Goode and Hastings, 1989). Community characteristics might have changed dramatically since the time the data were collected, lessening the applicability of the model results. An updated version of such a model would be very useful for local communities to use when targeting industries.

The final targeting tool to be discussed is multiplier analysis. Generating multipliers is the most common application of input-output models. Multipliers can also be calculated without an input-output model, using easily accessible data (Hustedde,



Shaffer, and Pulver, 1993; and Shaffer, 1989). Sector multipliers measure the intersectoral linkages that exist in an economy. The larger the multiplier, the larger the impact on the economy. Multipliers can measure the direct, indirect and induced effects of exogenous changes in the economy. Output, income, value-added and employment multipliers are often of the most interest to localities. Communities will often select industries having large multipliers for their targeting efforts. The multiplier used in a particular targeting study depends on the purpose of the analysis.

Because multipliers are often misused and misinterpreted, the local impacts of a firm targeted in this manner may be disappointing. The most common misuse of a multiplier is the use of the output multiplier rather than the value-added multiplier of a sector to estimate local impact. Output multipliers are usually very large because of double counting of interindustry output. Next, a temporal dimension is generally not included in multiplier analysis. It may take several years for the full indirect and induced effects to be fully felt in the local economy. Finally, a multiplier is a ratio: the total effect divided by the direct effect. A sector having a large multiplier may have only a small total effect on the economy. The large multiplier may occur only because of an even smaller direct effect. What a community should be targeting is a sector that has a large total effect, rather than a sector with a large multiplier.

Input-output models generate other data that can be used in a multitude of ways. Johnson (1995) used a combination of income and employment multipliers to calculate the per job income for the sector itself and to calculate the average income of all jobs

created as a result of a sector's impact, which was used to target sectors. In another study income per person, total income per dollar of output, the growth rate, and employment per million dollars of output, as calculated by a popular input-output model, were used to target industries (Johnson, Wade, and Archambault, 1994).

The studies and tools described identify many of the variables that should be considered when targeting industries. Things such as export and import opportunities, fiscal impacts, growth potential, and total expected impacts on output, employment, income, and value-added all contribute to an industry's attractiveness to a community. What are not being considered in most cases are the non-economic impacts.

In addition, sectors that are missing in the local economy are ignored for targeting because there are no data available to support their being targeted. In order to use the tools described above, data concerning an industry's sales, purchases, and employment for the local area (at the very least) must be available. If an industry is not represented in a community, the calculations can not be performed. This eliminates sectors from consideration that may have presented substantial growth opportunities for a local economy.

Most communities can only consider a limited amount of information in targeting efforts. Consideration of every aspect using the above tools would consume large amounts of time and money. In addition, the new philosophy behind economic development explicitly calls for community involvement (Isserman, 1994). None of the methods mentioned take community preferences into consideration

Local preferences are becoming more important as people become more aware of the many different impacts caused by development and the amount of public funds that are being spent to affect firm location. Localities are vocal about their preferences. The Disney America project that was proposed for Virginia is one example. The public outcry that arose and succeeded in canceling the project demonstrates what can happen if development officials fail to consider community preferences when making development decisions.

This research uses input-output data to initially screen industries for targeting. Later steps involve identifying and measuring firm impacts that may be important to communities. Community preferences are included in the industrial targeting process using the Analytical Hierarchy Process. This research uses several of the traditional tools, as well as a few non-traditional tools, to identify industries for targeting.

### **Section 3.4: Input-Output Analysis**

Input-output (I/O) modeling was developed by Wassily Leontief in the late 1930s (Miller and Blair, 1985). I/O models have become widely used in regional economics since that time. I/O provides a framework for measuring the linkages among sectors<sup>3</sup> in a region's economy. The model is based on observed economic data for a specific geographical area (e.g. a county, state, or nation). The transactions table, the basis of the input-output system, keeps track of the flow of goods from each sector to other sectors

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<sup>3</sup> The terms "sectors" and "industries" are used interchangeably.

and the final consumer. The flow of one sector's output to other industries reflects the intersectoral linkages in the economy. Goods sold to households, government, or as exports are considered final demand.<sup>4</sup>

There are several strong assumptions in input-output that affect the model's strengths and limitations. One assumption is that there is a fixed proportion of inputs for each unit of output. Fixed proportions imply there is no substitution between inputs due to price changes or new technology. Another assumption is that there are no economies of size. In order for output to double, every input used in production must double. Next, the input mix is assumed to be the same for large and small producers. In addition, all the firms in a sector are assumed to have a homogenous production function. If a sector called "vehicle construction" included firms involved in producing full-sized trucks and firms that produce golfcarts, the two firm types are assumed to use the same proportion of inputs. The final major assumption is that there is an infinite availability of primary inputs, including capital and labor. Because there are no resource constraints, there is no assumed production capacity. "In short, this model assumes that market structure, state of technology, relative prices and geographic distribution of economic interaction are fixed and that the supply of inputs and demand for output are elastic" (Hastings and Brucker, 1993, p. 10).

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<sup>4</sup> Households are part of final demand in Open I/O models only. For a discussion on open versus closed I/O models, see Miller and Blair, Chapter 2, pages 25-30.

### Section 3.5: IMPLAN

In the past, to use I/O in a study, a lot of time and money would need to be spent in primary or secondary data collection and in setting up the model. Today there are several pre-packaged I/O models available to researchers that can run on personal computers, including ADOTMATR, RIMS, and IMPLAN. IMPLAN,<sup>5</sup> originally created by the USDA Forest Service, contains comprehensive national data that can be used to estimate regional data on a county-by-county basis. This model allows the user to specify the geographic region of interest. In addition, it allows a user to edit the regional study area data and add her own information to the model. It is this flexibility that makes IMPLAN very effective in meeting the needs of various researchers.

The IMPLAN model is a rectangular model, meaning that the data are arranged on a commodity (C) by industry (I) basis. The data are recorded on a commodity by industry basis in order to reflect the fact that a single industry usually produces more than one commodity. However, the **A** matrix, which is fundamental to input-output, is an industry by industry matrix. In order to obtain the **A** matrix, IMPLAN performs several manipulations on the individual data matrices that are necessary to calculate the transaction matrix (Appendix A).

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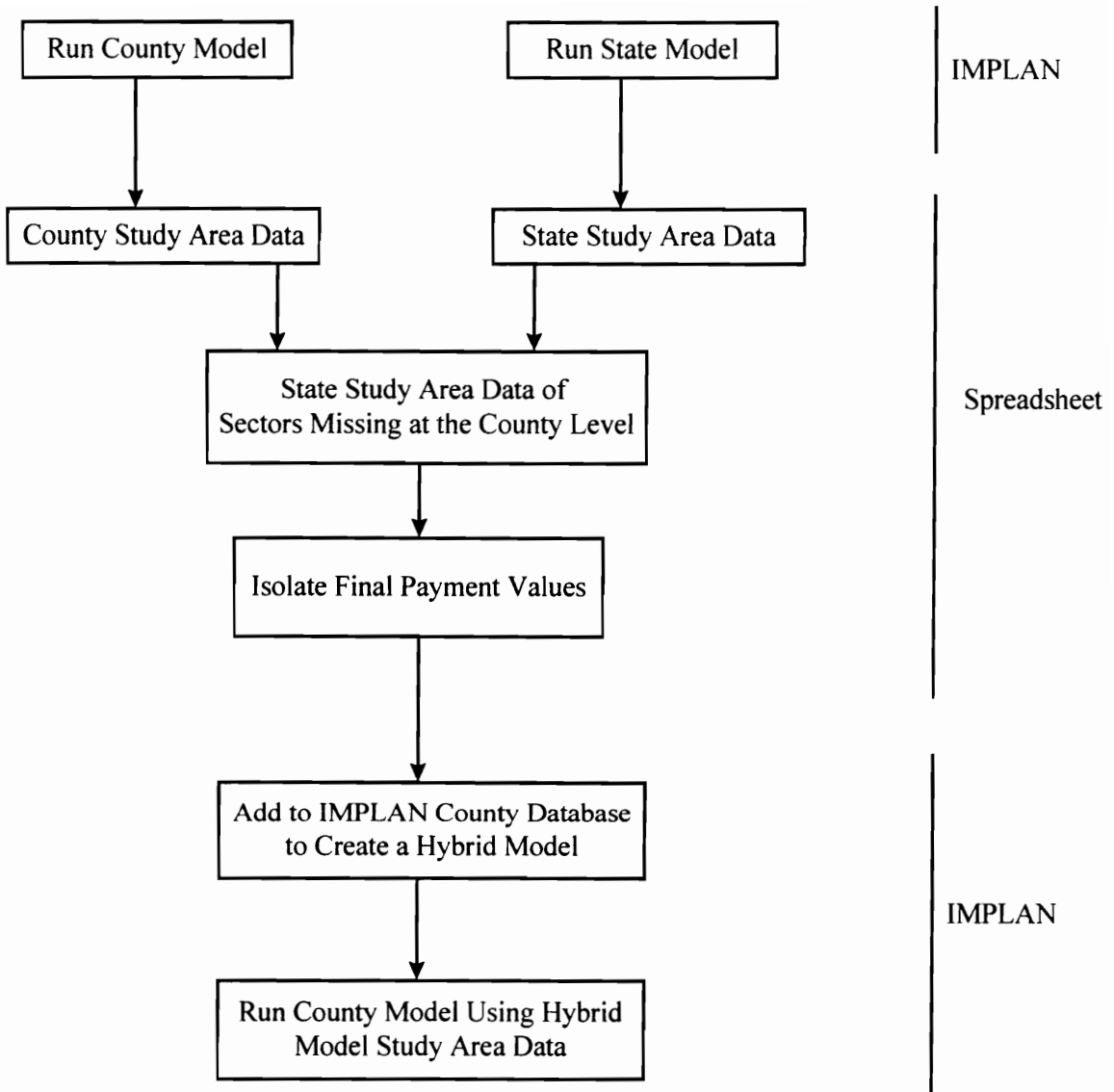
<sup>5</sup> "IMpact analysis for PLANning"

### **Section 3.6: Adding Sectors to the IMPLAN County Models**

When targeting industries it is important not to limit the prospects to the industries that have historically been present in a region. When a sector is not present in a region, IMPLAN does not include in the various matrices. To increase the number of prospective sectors, each county model must be expanded in this study to include sectors missing at the county level, but present at the state level.

Sectors missing from a county model are incorporated in this study into the county's regional social accounts by incorporating state final payment data into the county model. The final payment values include the elements of value-added (employee compensation, indirect business taxes, proprietary income, and other property income), total employment, and total output. Adding these elements to the county study area data leads to what is referred to as a hybrid model. When a county model is created using the hybrid study area data, IMPLAN is able to perform calculations for the sectors that were previously absent (Figure 3-2).

As mentioned, the industries presently operating in the state of Virginia are used to represent the entire set of possible industries for each county. It is assumed that the Virginia study area data that are used in the county models will yield results that are an acceptable approximation of the actual impacts that would be present if each individual sector that is added were to actually exist in the county in question. However, before the state-level final payment values of sectors missing at the county level are added to the county study area data, some calculations must be performed.



**Figure 3-2: Steps Used to Create a Hybrid Model**

For each of the county’s set of missing sectors, all of the sectors’ final payment values were divided by their respective total employment multiplied by one thousand,<sup>6</sup> in order to get small final payment values that will “nudge” the regional model (Equation 1).

$$\text{New Final Payment Value} = \left[ \frac{\text{Final Payment Value for Sector } i}{\text{Employment for Sector } i * 1000} \right] \quad (1)$$

The counties’ regional data files in IMPLAN are edited to include the newly calculated final payment values. When the sectors are added to a county model in this manner, it is interpreted as if one job (person-year equivalents) in that sector were present, with the resulting value-added and output that a single person employed in that sector would create.

It is necessary for the final payment values to be added to each county model to be small in order to keep the deflationary effects to a minimum. As sectors are added to the county models, the existing sectors’ RPCs become smaller. Lower RPCs have the effect of decreasing the impacts calculated by IMPLAN. In order to keep the deflationary effects to a minimum, it was necessary for the small final payment values for each sector that was to be added to a county model to be very small.<sup>7</sup>

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<sup>6</sup> All the study area data are in millions, except for employment, which is in thousands. In order to get everything in the same units, it is necessary to multiply the total employment by one thousand.

<sup>7</sup> To further explore the effects of adding sectors in the described manner to the model refer to Appendix B.



### **Section 3.7: Determining the Initial Set of Sectors for Possible Targeting**

There are 528 sectors in the IMPLAN Model. Of these sectors, 459 are represented in the state of Virginia. The sectors present at the state level, but missing at the county level, need to be added to the county models in the manner described above. However, it is unreasonable to target many of these sectors because they are not footloose. Sectors are eliminated from further consideration if they are factor-oriented, such as the agricultural and mining; market-oriented, such as the retail and certain services sectors; and if they are unattractive for environmental reasons. The final criteria is subjective and should be used as little as possible. However, it is difficult to imagine any community proactively targeting certain sectors, such as an industry that manufactures asbestos products (IMPLAN code 249).

After eliminating the sectors meeting the criteria listed above, the total value-added effect of each sector is used to screen the remaining sectors. Total value-added was used because it is a good measure of the local impact of a sector. Value-added is the dollar value of sales less the cost of intermediate inputs. The total value-added effect is the value-added generated through the local economy per each additional dollar of output for the sector in question. The total value-added effect includes the direct, indirect, and induced effects. The direct effect is the original or exogenous change in the level of value-added. The indirect effects are the subsequent changes in the economy due to backward linkages among industrial sectors. The induced effects are the changes in the

economy due to changes in household spending, which are “induced” by the direct and indirect effects. The larger the total value-added effect, the higher the rank of that sector.

The value-added multiplier was not used because comparisons between sectors is less meaningful than comparing two sectors’ value-added effects. A value-added multiplier for a sector is defined as the total value-added (from all sectors) divided by the direct value-added (from the original sector). The value-added multiplier for each sector has a different denominator, which is what lessens any meaningful comparisons. A more direct method of comparison is to look at the total value-added effect of each sector. The denominator in this case is output. The value-added effect can be described as the total value-added per dollar of output. This is consistent for all sectors, making the value-added effect a better tool when comparing industries.

Only the 100 highest ranking sectors were used in further steps. Limiting the number of sectors considered further in the study to 100 is arbitrary. The community preferences for firm impacts determine which sectors are targeted. Before that is done, the methods by which the community preferences of impacts were obtained are explained.

### **Section 3.8: Elicitation of Preference Rankings**

The quality of life of the residents in the locality where development occurs is influenced by environmental, social, and economic factors. Because quality of life is intrinsically subjective, researchers have found it difficult to explicitly measure the importance of different factors. The next several steps of the study involve eliciting

community leaders' preferences for the impacts felt by the local community following successful attraction of a new firm or expanding an existing one. Shaffer (1989) defines an impact as the interaction between the development event and the community. For this research, the development event is assumed to be the successful attraction of a new firm or the expansion of an existing firm to the local economy. The impacts include several of the economic, social, and environmental consequences that follow the development event.

The Analytical Hierarchy Process (AHP), developed by Saaty (1980), is used to develop a weighting or prioritization of impacts. The AHP belongs to the field of analysis called multi-attribute decision making. A few of the other widely used techniques in multi-attribute decision making analysis include multi-objective goal programming, influence diagrams, and decision trees. All of these techniques take complex problems and break them down into their component parts for easier analysis by the decision maker.

The AHP is a mathematical model that provides a systematic way of representing a problem. Through a system of pairwise comparisons the relative importance of the different impacts resulting from economic development can be measured. This measurement includes those impacts that are subjective in nature. Even with subjective criteria included in the model, the weights obtained through the AHP are "ratio scale numbers and correspond to so-called hard numbers" (Saaty and Kearns, 1985, p. 19).

Knowing the importance, or the weight, that community leaders assign to different firm impacts, including the subjective impacts, can help those leaders better target industries that have desirable qualities. Communities have given weights to firm characteristics in the past. In fact, Shaffer (1989) recommends the use of a screening matrix system where a community assigns weights to the set of firm characteristics desired by the community. Johnson, Wade, and Archambault (1994) also had community members assign weights to a list of screening criteria that were used to identify industries for targeting.

The Analytical Hierarchy Process “elicits judgments directly and uses them to synthesize priorities” of objective and subjective criteria (Saaty and Kearns, 1985, p. 60). It is superior to simply having a person assign weights to impacts because it forces participants through a series of pairwise comparison judgments of each criteria under consideration, rather than asking respondents to simultaneously compare all the impacts. The pairwise comparison process imposes rigor on the judgment process that is missing when directly assigning weights to a number of impacts, because possible inconsistencies in the judgments can be calculated and reexamined.

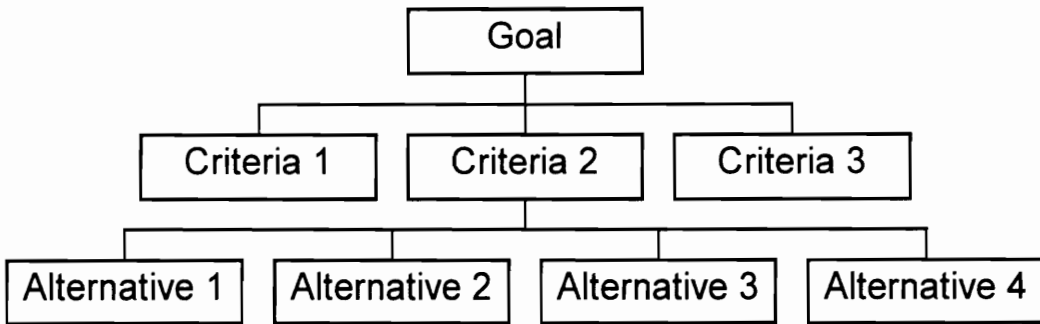
Saaty (1980) warns that researchers should take care when asking study subjects to simultaneously compare items unless the judgments over the items being compared are known to be consistent. One of the foundations of the AHP is the observation that human decision making is not always consistent. Consistency often suffers when the criteria being compared are subjective in nature. The Analytical Hierarchy Process is superior to

simultaneous comparison because it allows inconsistency among the judgments. This technique also provides a standard by which the consistency of judgments can be measured. If the inconsistency of the judgments exceeds an established threshold then participants know they need to re-examine their judgments.

This technique has been applied in many different fields, including electric utility planning, portfolio management, conflict management, advertising, and resource allocation (for examples, see Hämäläinen Seppäläinen, 1986; Lauro and Vepsäläinen, 1986; Saaty and Alexander, 1989; Dyer, Forman, and Mustafa, 1992; Saaty, 1980). The common link between the applications of AHP is that the problems being addressed are complex. The decision maker has to choose between multiple alternatives with respect to a list of criteria, which in many cases were subjective in nature. The Analytical Hierarchy Process provides a means of presenting each of these problems in an organized manner and allows the decision maker to explicitly take into consideration the subjective criteria as well as the objective criteria.

### *Section 3.8.1: Structuring the Problem*

The first step in the AHP is to decompose the problem into a dominance hierarchy (Figure 3-3). The top-most level represents the goal or focus of the problem. The intermediate levels are the criteria on which the lower levels depend. To complete the process, the lowest level is the list of choices or alternatives (Saaty and Kearns, 1985).



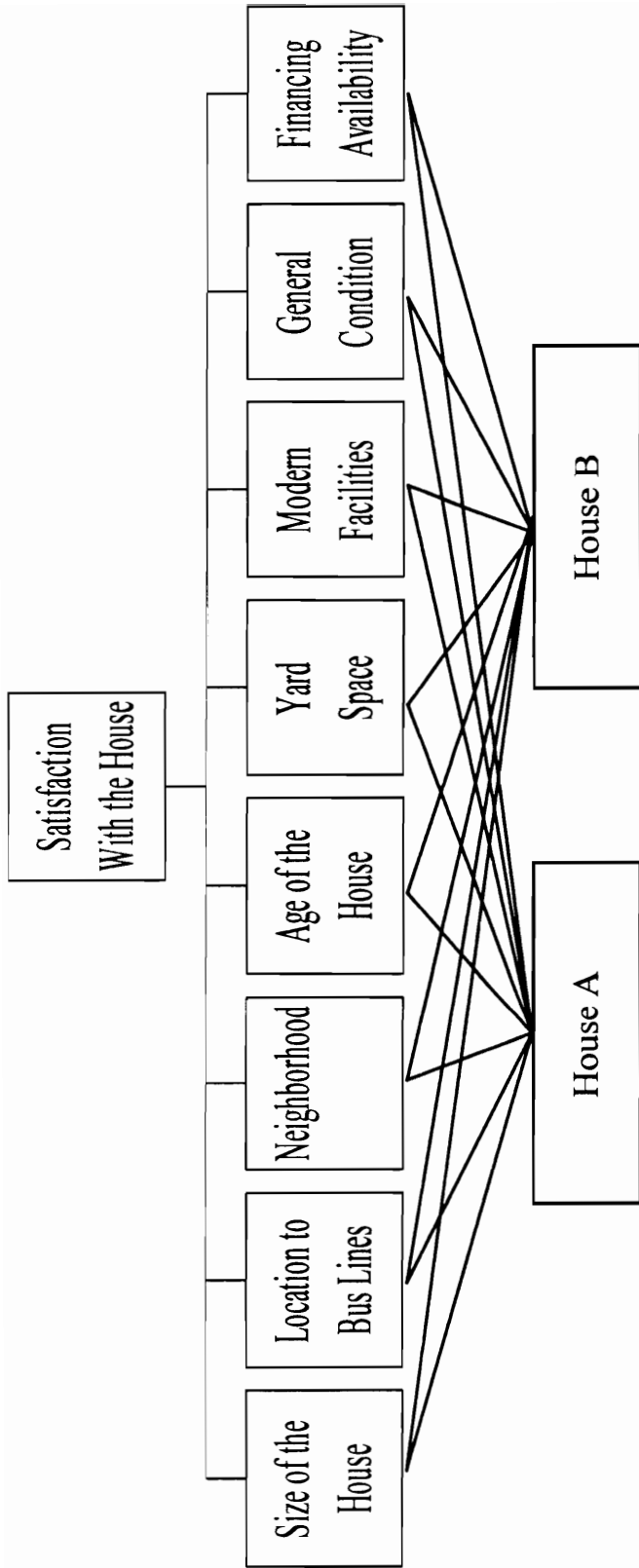
**Figure 3-3: Generic Decomposition of a Problem into A Dominance Hierarchy**

As many levels as necessary can be used in this technique. The only constraint is that the lower levels act as the criteria or factors contributing to the level immediately above.

An example taken from Saaty and Kearns (1985) illustrates how a problem can be decomposed into a hierarchy in the manner described above. Figure 3-4 is the dominance hierarchy associated with a family who faced with the problem of purchasing a house. The goal of the problem is to determine the “Satisfaction with the House.” The family identified eight criteria that would contribute to the goal: Size of house, location to bus lines, neighborhood, age of house, yard space, modern facilities, general condition, and financing availability. In the third level are the houses that are evaluated in terms of the criteria in the second level (Saaty and Kearns, 1985).

### *Section 3.8.2: Pairwise Comparison*

Once the problem is decomposed into a hierarchy, each element must be compared to the other elements at that same level, with respect to the level directly above. The questions asked could take the form of “When comparing different criteria, which criterion is more important (in achieving the goal)?” for the second level. The question may become “In comparing different alternatives with respect to a criterion, which alternative is more desired?” for the third level (Saaty and Kearns, 1985). Other kinds of questions that could be asked include: “When comparing A and B, ‘Which is more important?’ ‘Which has a greater impact?’ ‘Which is more likely to happen?’ and ‘Which is more preferred?’” (Saaty and Kearns, 1985). The nature of the question depends on the desired outcome and the level being compared.



**Figure 3-4: Decomposition of Choosing a House**

Source: Saaty and Kearns, 1985



In practice, to make the items being compared clear, each level of the hierarchy is reduced to a matrix form. Matrix format is also necessary to solve for the priority weights of each level of the hierarchy. As participants respond to each question, the resulting judgment is entered into the matrix. The matrix is square, with each of the criteria representing a column and a row (Table 3-1). The  $p_{ij}$  is the numerical answer to the question (using the generalized problem from Figure 3-2), “With respect to the goal, what is the importance of criteria  $i$  versus criteria  $j$ ?” The matrix is reciprocal, with  $n(n-1)/2$  pairwise comparisons, where  $n$  represents the number of criteria (Equation 2):

$$p_{ij} = \frac{1}{p_{ji}} \quad \text{and} \quad p_{ii} = 1 \quad (2)$$

where  $i$  and  $j$  refer to the row and column, respectively, where any entry is located.

Considering Table 3-1, for three criteria, there are  $3(3-1)/2 = 3$  comparisons to make.

The matrix is read from row to column. For example, if criteria  $i$  is more important than criteria  $j$ , the scale value representing the intensity is entered directly into the matrix position  $p_{ij}$ . However, if criteria  $j$  is more important than criteria  $i$ , the *reciprocal* of the scale value representing the intensity is entered into the matrix position  $p_{ij}$ . When a criteria is compared with itself, it takes on the judgment value of one. Using the scale of comparison discussed later, this means each impact is equally important when compared to itself, which is logical.

**Table 3-1: Generalized Pairwise Comparison Matrix for Level Two**

	<b>Criteria 1</b>	<b>Criteria 2</b>	<b>Criteria 3</b>
<b>Criteria 1</b>	$p_{11} = 1$	$p_{12}$	$p_{13}$
<b>Criteria 2</b>	$p_{21} = 1/p_{12}$	$p_{22} = 1$	$p_{23}$
<b>Criteria 3</b>	$p_{31} = 1/p_{13}$	$p_{32} = 1/p_{23}$	$p_{33} = 1$

Assuming the comparisons are completed, the judgment or priority matrix can be represented in actual matrix format (versus in a table) as (Equation 3):

$$\mathbf{P} = \begin{bmatrix} p_{11} & p_{12} & p_{1j} & \cdots & p_{1n} \\ p_{21} & \ddots & & & \vdots \\ p_{i1} & & p_{ij} & & \vdots \\ \vdots & & & \ddots & \vdots \\ p_{n1} & \cdots & \cdots & \cdots & p_{nn} \end{bmatrix} \text{ for } i, j = 1 \dots n \quad (3)$$

If the weights of the criteria being compared were known, the  $p_{ij}$  would represent the ratio of the weights of the elements being compared (Equation 4).

$$\mathbf{P} = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \frac{w_1}{w_j} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \frac{w_2}{w_j} & & \vdots \\ \frac{w_j}{w_1} & & \frac{w_j}{w_j} & & \vdots \\ \frac{w_i}{w_1} & & \frac{w_i}{w_i} & \ddots & \vdots \\ \vdots & & & \ddots & \vdots \\ \frac{w_n}{w_1} & \cdots & \cdots & \cdots & \frac{w_n}{w_n} \\ \frac{w_n}{w_1} & \cdots & \cdots & \cdots & \frac{w_n}{w_n} \end{bmatrix} \text{ for } i, j = 1 \dots n \quad (4)$$

When the weights ( $w_1, w_2, \dots, w_n$ ) are unknown, then the pairwise comparison is performed using subjective judgments estimated numerically from a scale of numbers. The scale recommended by Saaty has been validated for effectiveness in different applications (Table 3-2) (1977). In effect, the scale of priorities gives the people making the comparisons translation rules. These translation rules help people verbalize their preferences (Fichtner, 1986).

**Table 3-2: Scale of Relative Importance**

<b>Intensity of Relative Importance</b>	<b>Definition</b>	<b>Explanation</b>
1	Equal importance.	Two activities contribute equally to the objective.
3	Moderate importance of one over another.	Experience and judgment slightly favor one activity over another.
5	Essential or strong importance.	Experience or judgment strongly favor one activity over another.
7	Demonstrated importance.	An activity is strongly favored and its dominance is demonstrated in practice.
9	Extreme importance.	The evidence favoring one activity over another is of the highest possible order of affirmation.
2, 4, 6, 8	Intermediate values between the two adjacent judgments.	When compromise is needed.
Reciprocals of above non-zero numbers	If an activity has one of the above number (e.g. 3) compared with a second activity, then the second activity has the reciprocal value (i.e., 1/3) when compared with the first.	

Source: Saaty and Kearns, 1985

### Section 3.8.3: Solving for Preference Weights

Obtaining the relative weights would simply be Equation 5 if there were no errors, or inconsistencies, in the pairwise comparison. In such a case,  $\mathbf{w}$  can be solved as an eigenvector of  $\mathbf{P}$  corresponding to an eigenvalue equal to  $n$ , which, in the perfectly consistent case is also the rank of the matrix (Saaty, 1980).

$$\mathbf{P}\mathbf{w} = n\mathbf{w} \tag{5}$$

$\mathbf{P}$  = comparison matrix

$\mathbf{w}$  = eigenvector corresponding to  $n$

$n$  = number of rows (or columns) in  $\mathbf{P}$

The actual elements of the  $\mathbf{P}$  matrix, though, do contain error terms, or inconsistencies.

The inconsistencies can be partially attributed to the limitations put on the comparison by the scale being used. That is, the  $p_{ij}$  is based on subjective judgments, not on exact measurements. The judgment matrix is not really a ratio of  $w_i/w_j$ , but only the numbers and their reciprocals that are used in the scale. By using only integers and their inverse the rounding error can be up to 50 percent (Fichtner, 1986).

Human error is also the cause of the inconsistencies that appear when solving  $\mathbf{P}$ .

The prior rankings of each pair of elements is difficult for people to consider as they compare other criteria. This limitation is the primary justification for keeping the number of elements to be compared at each level of the hierarchy below nine. Given this error, we use the maximum eigenvalue in place of  $n$  to solve for  $\mathbf{w}$  (Saaty, 1980) (Equation 6):

$$\mathbf{P}\mathbf{w} = \lambda_{\max} \mathbf{w} \quad (6)$$

$\lambda_{\max}$  = maximum eigenvalue of  $\mathbf{P}$

$\mathbf{P}$  = comparison matrix

$\mathbf{w}$  = eigenvector corresponding to  $\lambda_{\max}$

Two facts of matrix theory provide a basis for use of the maximum eigenvalue to calculate  $\mathbf{w}$ . First, if  $\lambda_1, \dots, \lambda_n$  are the eigenvalues of  $\mathbf{P}$  that satisfy the equation

$\mathbf{P}\mathbf{x} = \lambda\mathbf{x}$ , and if  $p_{ii} = 1$  for all  $i$ , then (Equation 7):

$$\sum_{i=1}^n \lambda_i = n \quad (7)$$

If a matrix is perfectly consistent, as must be the case when using Equation 5, “then all eigenvalues are zero, except one which is  $n$ . Clearly, then, in the consistent case,  $n$  is the largest eigenvalue of ( $\mathbf{P}$ )” (Saaty, 1980, p.51).

The second item helping to justify using the maximum eigenvalue to calculate  $\mathbf{w}$  is the fact that small changes in  $p_{ij}$  of a positive reciprocal matrix  $\mathbf{P}$  cause small changes in the eigenvalues. Combining these facts, if the diagonal of a matrix  $\mathbf{P}$  consists of ones ( $p_{ii} = 1$ ) and if  $\mathbf{P}$  is consistent, then small variations of the  $p_{ij}$  “keep the largest eigenvalue,  $\lambda_{\max}$ , close to  $n$ , and the remaining eigenvalues close to zero” (Saaty, 1980, p.51).

To obtain the set of weights or preference of the criteria or impacts, the eigenvectors as calculated from the largest eigenvalue,  $\lambda_{\max}$ , of the matrix  $\mathbf{P}$  are calculated

and then normalized. For the vector  $\mathbf{w}$  each element needs to be divided by the sum of the elements to normalize the prioritization (Equation 8).

$$\mathbf{w} = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} \text{ and } T = \sum_{i=1}^n w_i \quad (8)$$

The weight of the criteria becomes:  $\frac{w_i}{T}$

These results are not just the ordinal ranking of each criteria, but are the cardinal, or relative, values (weights) of the criteria. (For more detailed information on the AHP see Saaty, 1980)

#### *Section 3.8.4: Consistency*

One of the strengths of using the AHP is the ability for preference weights to be solved even in the advent of intransitivity among criteria and inconsistency in the actual intensity with which the judgments are expressed. In addition, the AHP provides a way for the inconsistencies to be calculated. If the inconsistency of judgments is too great, the results of the AHP are not reliable. In order to make the researcher and those volunteering their preferences confident of the results, it is desirable for the judgments to fall within a certain threshold of consistency.

First, using  $\lambda_{\max}$ , the Consistency Index (C.I.) is calculated using Equation 9, where  $n$  is the number of elements being compared.

$$\text{Consistency Index} = \frac{(\lambda_{\max} - n)}{(n - 1)} \quad (9)$$

The second step is to compare this value to the Random Index (R.I.) value, which is created by filling a matrix of the same dimensions as is being used by the researcher and randomly taking judgments from the Scale of Relative Importance (Saaty, 1980). Several tests were conducted to determine the R.I. for different order of matrices. The results are presented in Table 3-3.

The final step is to calculate the Consistency Ratio (Equation 10). The Consistency Ratio is the ratio of the C.I. to the average of the R.I. for the same order of matrix, where n represents the order of the matrix. Saaty and Kearns (1985) suggest a C.R. between .10 and .20 is acceptable. Of course, the most desirable C.R. would be below .10, indicating low inconsistency.

$$\text{Consistency Ratio} = \frac{\text{Consistency Index}}{\text{Random Index}} \quad (10)$$

The level of the C.R. that is acceptable is also subject to the problem being examined. If it is very important that judgments be as reliable as possible the researcher should aim for a C.R. as close to zero as possible. More latitude might be given in situations where the absolute consistency of judgments are less important. If the C.R. is too high, the comparisons need to be reexamined until the C.R. is within the bounds set by the researcher.



**Table 3-3: Random Consistency Index for Matrices of Order 1 through 15**

<b>Order of Matrix</b>	<b>Randomly Generated Index of Consistency</b>
1	0
2	0
3	.58
4	.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

Source: Saaty, 1980

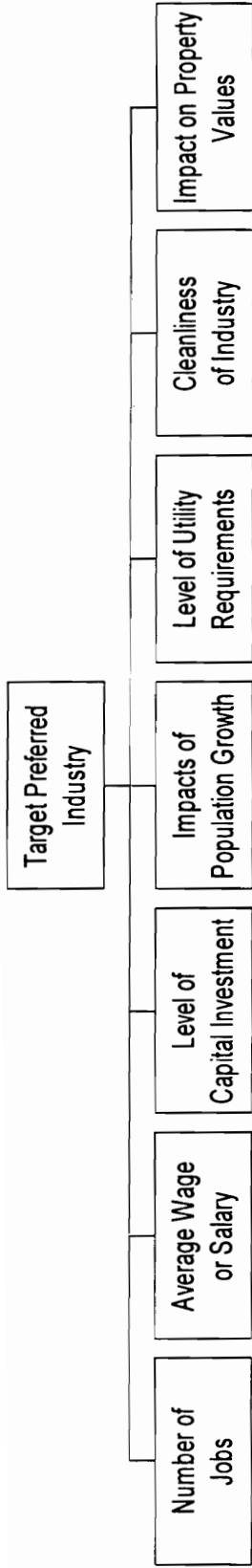
### **Section 3.9: Structure of the Problem for Industrial Targeting**

While most applications of the AHP are interested in determining which of the alternatives best achieves the goal, AHP can be valuable for deriving weights of the criteria that can then be used in a variety of other ways (Dyer, Forman, and Mustafa, 1992). With this in mind, two levels are used in structuring the hierarchy for the purpose of this research. The top level is the goal of the problem. The second level consists of the criteria that contribute to reaching the goal.

Because the problem being addressed deals with industrial targeting, it follows that the highest level of the hierarchy, the goal, would be to target the most attractive industry. The second level then represents the criteria by which the top level is judged. In this case, the criteria consist of possible impacts firms have on a locality (Figure 3-5).

Again, the third level, a list of alternatives, is not included. One of the basic premises of using the AHP is that the participants in the study be considered “experts” in the problem area (Saaty, 1980). Because the participants in each case study area will have little knowledge of the industry alternatives that would be in the third level of the hierarchy, their judgments would be questionable.

There are two main constraints to consider when compiling a list of criteria. First, to keep the comparisons relevant, no more than  $7 \pm 2$  elements can be used at any one level (Saaty and Kearns, 1985). It has been determined that individuals have difficulty considering more than nine elements. Having more than nine elements at any level often leads to significant inconsistencies in the prioritization of the criteria, thereby weakening



**Figure 3-5: Decomposition of the Industrial Targeting Problem**

the results. Second, later steps involve valuing the level of the included impacts for each industry in each case study area. Due to the subjective nature or difficulty in obtaining accurate data for some of the impacts, the “true” value of those impacts are generally unknown and must be estimated.

### *Section 3.9.1: Choosing the Criteria*

The different impacts used in this study were chosen to reflect some of the important economic, public, and environmental impacts firms might have on a community. There are seven different impacts included as criteria affecting the goal of targeting a preferred industry. The impacts are: number of jobs, average wage or salary, level of capital investment, impacts of population growth, level of utility requirements, cleanliness of industry, and impacts on property values. Each impact is broadly defined for the purposes of this study (Table 3-4).

The economic impacts considered in this research were chosen because of their demonstrated importance to communities. The number of newly created jobs offered by a recruited or expanded firm is often touted by politicians as an indication of how successful a community is in their economic development efforts. The number of jobs created by a firm is also a criterion included in targeting studies (Doescher, Dauffenback, and Warner, 1986). Shaffer (1989) also discusses the number of jobs offered by a firm as being a consideration in economic development. Not only the literature supports the supposition that increased employment in a community is an important consideration. Levy and Stephenson (1994) surveyed 900 directors of economic development agencies,

**Table 3-4: Definitions of Impacts**

<b>Impact</b>	<b>Type</b>	<b>Definition</b>
Number of Jobs	Economic	Number of full-time equivalent positions.
Average Wage or Salary	Economic	Sum of all payments to employees divided by the number of jobs.
Level of Capital Investment	Economic	Amount of money spent on buildings, facilities, and equipment.
Impacts of Population Growth	Public	Impacts that result from population increases such as increased traffic, greater number of children in local school classrooms, and a greater use of local services and facilities.
Level of Utility Requirements	Public	Level of sewer, water, and electricity use.
Cleanliness of Industry	Environmental	Visual air pollution, odor, appearance of facilities, other known effluents or waste products.
Impacts on Property Values	Public	Impacts on property values that result from various firm attributes, such as pollution or labor force changes.

and of the 428 usable surveys, agencies listed increasing employment as being the most important goal or objective of economic development. There are several Virginia state-level incentives that have minimum employment-size requirements a firm must meet in order to qualify for incentives (Commonwealth of Virginia, 1995). Counties may also have similar requirements. For example, Montgomery County has minimum job-creation requirements a firm must meet in order to qualify for county incentive money (Montgomery Regional Economic Development Commission, 1995).

The average wage or salary offered by a firm is frequently cited in many arenas as something in which localities should be or are interested. Higher wages are often a indication of the quality of job offered by a firm. The average pay offered by a firm is used as a screening criteria in industrial targeting studies (Lee, 1987; Doescher, Dauffenback, and Warner, 1986). Bartik (1995) and Shaffer (1989) suggest that more incentives should go to firms that have higher than average wages.

The number of state incentives that have minimum capital investment levels demonstrates the importance of including the level of capital investment as part of the criteria for identifying a preferred industry comes. Of the state-level incentive programs, eight have minimum capital investment requirements (Commonwealth of Virginia, 1995). Capital investment might be important for two reasons. First, firms having a higher stake in a community, as measured by their level of capital investment, might be less likely to relocate in the future. Second, localities are interested in increasing the stream of

property tax revenues they receive. The more capital investment from a firm, the more tax revenues for the community.

The level of utility requirements was included in the study as a measure of how important local utility capacity constraints are to community leaders. In a survey conducted by Bailey (1996) of state economic development professionals, frequent responses indicated that firm levels of water and sewer demands were a concern or at least a consideration when granting incentives.

An impact not often considered in targeting studies is the impact increased development might have on property values. This is a factor that is difficult to explicitly consider because of lack of knowledge, *ex ante*, about how a development event will affect property values. However, the impact on property values was the second most important objective listed by development agencies in the Levy and Stephenson (1994) survey. Property values are important to the local government primarily because increased property values increase the tax base for a locality.

There has been increased interest in including non-economic impacts in the development process. Daley and Angulo (1990) describe traditional analytical methods of economic development as “synoptic planning,” which ignore the people of the community and their thoughts, feelings, and desires. They suggest that community-centered planning, where it is recognized that community residents are “historically grounded, value-oriented human beings” should replace the traditional analytical planning (p. 89). In economic terms, residents derive utility from more than just having a

job and income, and therefore a community should be concerned with more than just income and employment levels. The development activities in a community should recognize and consider non-economic impacts and the community preferences for the different impacts.

Third Wave principles recognize the importance of community involvement and consideration of community desires in the development process. Still, the non-economic considerations are often difficult to explicitly consider. The four criteria included in this research are non-economic in nature, and are an attempt to explicitly consider environmental and public impacts.

The cleanliness of industry is included to determine how important environmental considerations are to communities. There has been a lot of attention given to studying the environment in the past several years. Yet this is an impact that has not received attention with respect to how it might affect a community's decision to accept a firm and grant it public money. Including this impact as something that affects the attractiveness of an industry to a recruiting locality is important.

The impacts of population growth is a measure of several of the costs that are associated with economic development, specifically, the costs associated with a larger population. This criterion represents what might be considered mainly social costs of development. For example, an increase in the population, caused by in-migration, may increase the time it takes residents to travel to and from work, or the greater use of a local park make it less attractive to a long time resident. This affects the quality of life of the



local residents. While not often an explicit factor in development, the fifth most frequently listed goal or objective of economic development agencies in the Levy and Stephenson (1994) survey was to increase the quality of life in their area.

### **Section 3.10: Scoring Industry by Each Impact**

In order to use the priority vector (the weights for different impacts) calculated from the Analytical Hierarchy Process to evaluate possible industries for targeting, each of the top 100 industries identified by earlier steps must receive a score for each impact. Average number of jobs, average wage or salary, average level of capital investment, and impacts on property values are positive impacts. An industry having a larger value for these four impacts will receive a higher score. An industry having a larger value for the remaining criteria, level of utility requirements, cleanliness of industry<sup>8</sup> (measured by the level of pollution), and the impacts of population growth, receives a higher negative score.

Each impact is scored using a relative scale. The industry with the largest impact receives the largest score of 100 (or -100 for the negative factors). The score received by each remaining industry is the percentage of that industry's impact of the highest impact level (Equation 11).

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<sup>8</sup> The cleanliness of industry, because it is measured using pollution levels, could also be called "dirtiness of industry" without changing how the impact is used for this research.

$$\text{Score for Industry } i = \left( \frac{\text{Impact Level of Industry } i}{\text{Impact Level of Industries 1}} \right) * 100 \quad (11)$$

for  $i \neq$  Industry 1  
 Industry 1 = Industry with the highest impact value

For example, if Industry A has the highest impact level of 8700 (units are immaterial), and Industry B has the second highest impact level of 8300, Industry A receives a score of 100, and Industry B's score is calculated to be 95.4 using Equation 11.

### Section 3.11: Measurement of Impact Levels

The average number of jobs, average wage or salary, average level of capital investment, and the average level of utility requirements, are calculated using national model data from IMPLAN. The national study area data list the total employment, total compensation to employees, payments to proprietors, and total output for each sector at the national level. Obtaining the average number of jobs per dollar in output is straightforward (Equation 12). The total employment for industry includes the direct, indirect, and induced employment for each sector, as calculated by IMPLAN.

$$\text{Average Employment for Industry } i = \left( \frac{\text{Total Employment for Industry } i}{\text{Total Output for Industry } i} \right) \quad (12)$$

The larger the average employment, the larger the score. The average wage or salary of each industry is similarly solved (Equation 13):

$$\text{Average Wage for Industry } i = \left( \frac{\text{Total Employee Compensation for Industry } i}{\text{Total Employment for Industry } i} \right) \quad (13)$$

The IMPLAN variable “payments to proprietors” is used to calculate the average level of capital investment of each industry per dollar of output. Because payments to proprietors represent the returns on capital investment accruing to the owners, shareholders, and lenders of each industry, it is reasonable to use it as a proxy for the actual level of average capital investment by industry. Using the study area data for the national model, the average level of capital investment becomes (Equation 14):

$$\text{Average Level of Capital Investment for Industry } i = \left( \frac{\text{Proprietor's Income for Industry } i}{\text{Total Output for Industry } i} \right) \quad (14)$$

National IMPLAN model data were also used to calculate the average level of utility requirements per one dollar of output for each industry. The data used to calculate this impact were obtained from the Direct Coefficients Matrix. Each column represents the purchases made by one sector, say sector  $i$ , of all the rest of the sectors in the economy needed for the production of one dollar’s worth of sector  $i$ ’s output. An industry’s use of water and sewage systems is approximated by its purchases from IMPLAN’s sector 512, Other Local Government Enterprises, which includes the local supply of sanitation, sewerage, water, gas, water transport and terminals, airports,

housing and community development, and liquor stores (Lindall and Olson, 1993).

Because of the inclusion of airports, housing and community development, and liquor stores, the use of sector 512 to represent the level of utility usage might lead to inflated estimates of this impact. However, it will be inflated for all of the 100 industries included in the study, although perhaps not equally. As mentioned above, industries with larger utility requirements will receive a higher negative score.

The 1993 Toxic Release Inventory (U.S. Environmental Protection Agency, 1995) lists the release of certain chemicals from manufacturing facilities into the environment. The inventory includes 316 chemicals from 20 chemical categories. Manufacturing firms report the amount of chemicals they release to the air, water, land, and into underground disposal wells. Also included in the report are the amount of listed chemicals transferred to other locations for disposal or recycling. The sum of the releases and transfers is used to represent the cleanliness of each industry, where industries using more of the chemicals included in the EPA report receive a larger negative score.

There are several limitations to these data. First, these data do not include all of the chemical pollutants in existence. Second, the level of chemical use does not necessarily directly correlate with higher health or environmental risk. Third, the data are only available at the two-digit SIC level. Within a two-digit SIC code all values will be equal. Fourth, the data do not include any pollutants associated with non-manufacturing industries. The industries not included are primarily agricultural, mining, service, and government service-related industries. The agricultural and mining industries have

already been eliminated from the set of possible target industries, so this is not a concern (see Section 4.3). It seems reasonable that, given the nature of service industries, they do not contribute much pollution to the environment. Therefore, the level of pollution entered for these industries is zero. Despite these limitations, the Toxic Release Report is the most comprehensive guide to environmental pollution and is sufficient for use in this research.

Estimating the impacts of population growth and changes in property values require several more steps than are needed for the other criteria. Also, it needs to be emphasized that the indices constructed for the purpose of this research are very rough. Exploration of estimation of population growth and property value impacts are left for further studies.

The population growth index that is eventually created is an indication of level of in-migration into the county that might occur for each industry. There are two main factors included in the formation of the index: the average number of employees of each industry, and the disparity between the demand of each skill level of an industry and the supply of each skill level in the local community, as measured by the average education levels. A similar index is created for the impacts on property values. In essence, for both impacts, industry is penalized for having worker skill-level requirements that differ from the existing worker skill-level structure in the county (explaining why the indices are squared).

Not all of the data used in creating the index were available at the four-digit SIC level. The highest level for which all the data were available is the two-digit SIC level, which is what is used in creating the index. Again, all industries within a two-digit SIC level will have the same value. With the index created for this criterion, the industries with a higher index value receive a higher negative score.

The first step in creating the population growth index is to determine the average employment of firms in each industry. This was done by dividing the total number of employees in each industry by the total number of firms in that industry, at the 2-digit SIC level (Equation 15).

$$\text{Average Employees / Firm for Industry } i = \left( \frac{\text{Total Employees for Industry } i}{\text{Total Number of Firms in Industry } i} \right) \quad (15)$$

The majority of the data for this calculation came from the 1992 Census of Manufacturing Preliminary Report Summary Series. Data for the non-manufacturing industries are obtained from the 1992 County Business Patterns for the United States. Data for the government “industries” are obtained from the 1994-95 Virginia Statistical Abstract. This is the only case where state rather than national data are used in the calculations of impact levels.<sup>9</sup>

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<sup>9</sup> IMPLAN data were not used because the number of firms represented in IMPLAN are unknown. To measure migration the average number of employees per firm was needed. This is not the case when the average employment (per dollar of output) was calculated earlier.

The second step is to determine the demand in each industry for people with different skill levels. The average proportion of high-, semi-, and low-skilled workers for each industry is calculated using US Department of Labor statistics. The Department of Labor uses seven job classifications for occupations (Table 3-5). In order to obtain the desired three skill-level categories, the seven job classifications used by the Department of Labor are collapsed into three categories, similar to the classification by Broomhall (p. 87 1991). The division of the occupation classes into high-, semi-, and low-skilled categories reflects, as much as possible, the amount of training and education required to perform the tasks of a particular job (Broomhall, 1991). With the occupational categories divided by skill level, the percentage of workers for each skill level used by industry can be calculated. This percentage is used to represent the demand that industry has for workers from each skill level.

The local “supply” of workers for each skill level is determined using educational attainment data, by county, from the 1994-95 Virginia Statistical Abstract. Occupations in Classes 1 and 2 (high-skilled category) require the highest levels of education, which is defined in this study as needing at least a four year degree. Classes 3 and 4 (semi-skilled category) generally require at least some training or education beyond a high school diploma. Classes 5, 6, and 7 (low-skilled category) may or may not require a high school diploma. It is assumed that the educational attainment levels of the unemployed are the same as those of the population as a whole (Table 3-6).

**Table 3-5: Description of Employment Categories by Skill Level and Class**

<b>Skill Level</b>	<b>Bureau of Labor Class</b>	<b>Description</b>
High	One	Professional, administrative, managers of technical and para-professional workers
	Two	Technical, para-professional, non clerical sales workers, managers of tradespeople, middle managers, contractors
Semi	Three	Tradespeople
	Four	Forepeople and managers of production, farm transportation, mining, clerical, and non-clerical service workers
Low	Five	Clerical and administrative support workers
	Six	Service workers
	Seven	Production, farm, mining, and transportation workers

US Department of Labor 1994, 1992, and 1990 and Broomhall p. 76 1991



**Table 3-6: Skill Levels and Corresponding Educational Attainment Levels, Bath County, Montgomery County, and Halifax County**

<b>Skill Level</b>	<b>Educational Attainment</b>	<b>Bath County (percent)</b>	<b>Montgomery County (percent)</b>	<b>Halifax County (percent)</b>
High	Bachelor's degree or higher	13	32	8
Semi	Up to 3 years or less of higher education or training beyond high school	17	21	16
Low	High school diploma or less	70	47	76

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The distribution of industry labor demands for the 100 industries considered are then compared to the distribution of labor in each county. The difference between the industry demand distribution and each county's labor skill-level distribution is squared and multiplied by the average number of jobs per firm for that industry and is used as an indication of migration (Equation 16). This assumes that the proportion of the population with a particular skill level is equivalent to the proportion of each skill-level in the community. Furthermore, it assumes that as the proportion of skilled jobs changes, the proportion of skilled people in the area will change. The more mismatch between the industry and the county, the more migration is expected to results.<sup>10</sup>

$$\text{Population Growth Index Value for Industry } i = \sum_{j=1}^3 (S_{kj} - M_{ij})^2 * N_j \quad (16)$$

Where:

$j$  = skill level: 1 = high, 2 = semi, 3 = low

$k$  = county: 1 = Bath County, 2 = Montgomery County, 3 = Halifax County

$S_{kj}$  = % population in a county  $k$  with skill level  $j$

$M_{ij}$  = % workers in industry  $i$  with skill level  $j$

$N_j$  = Average number of jobs needed by industry for skill level  $j$

The impact on property values is calculated in a similar fashion. It is assumed that migration is the main means by which industry location affects property values.<sup>11</sup> As more people want to purchase housing, the property values in an area will increase.

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<sup>10</sup> Does not account for potential retraining.

<sup>11</sup> Other factors (such as industry pollution levels) are also important. The refinement needed to better estimate the effect firms have on property values is left for future studies.

Using the method described above, labor demanded by each potential industry is divided into high-, semi-, and low-skilled categories. Because of the different average pay, it is assumed that the high- and semi-skilled workers will be more likely to purchase a home, while low-skilled workers will be more likely to rent. Another index of mismatch is created, this time with high- and semi-skilled categories combined. The distribution of industry labor demands for high- and semi-skilled workers is compared to the distribution of high- and semi-skilled labor in each county. The difference between industry distribution and the county distribution is squared and is used to indicate the number of people who will purchase a home. As more people who are more likely to purchase a home migrate to an area, the property values in that area will increase. The index is created by (Equation 17):

$$\text{Property Value Index for Industry } i = \sum_{j=1}^2 (S_{kj} - M_{ij})^2 \quad (17)$$

$j$  = skill level: 1 = high, 2 = semi,

$k$  = county: 1 = Bath County, 2 = Montgomery County, 3 = Halifax County

$S_{kj}$  = % population in county  $k$  with skill level  $j$

$M_{ij}$  = % workers in industry  $i$  with skill level  $j$

The index gives an indication of how much property values might change due to migration factors. It is recognized that the property value index does not incorporate many of the other factors that influence property values. A researcher would need to create a model that takes into consideration aspects of the community, conditions of local markets, and other industry characteristics that might affect property values. Without actually creating such a model, any adjustments would be contrived. Rather than

compute a complicated index that may or may not be accurate, it was decided that it would be better to keep the calculations simple.

### Section 3.12: Ranking Target Industries Using Local Preferences

At this point each impact has been scored for each industry included in this research. Now, the preferences of each county need to be applied to each of the industries for each of the impacts. In matrix notation (Equation 18):

$$\begin{bmatrix} \text{Final Vector} \\ \text{of Scores for} \\ \text{Industry} \end{bmatrix}_{100 \times 1} = \begin{bmatrix} \text{Matrix of Scored} \\ \text{Industry Impacts} \end{bmatrix}_{100 \times 7} * \begin{bmatrix} \text{Vector of Community} \\ \text{Preferences} \end{bmatrix}_{7 \times 1} \quad (18)$$

A higher score indicates a more preferred industry for that community. The results are displayed graphically in order to determine if there is a natural break in the scores. If so, the higher scored industries are those that should be targeted. If there is no obvious break in the data, the top 20 industries (an arbitrary number) will be discussed.

### Section 3.13: Summary of Methods

The 100 industries used in the scoring steps are initially chosen according the level of local impact, using the value-added effect, they had on each community. Each of the industry's impacts are then scored with reference to the largest impact of the set of industries, thereby making the industry levels relative to one another. The weights were multiplied by the scaled impacts, and summed for each industry. The results were then

ranked from the highest to the smallest, with the higher scoring industries representing the more preferred industries.

## Chapter 4: Results and Analysis

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### Section 4.1: Selecting the Participants

Before the Analytical Hierarchy process could be conducted, it was necessary to assemble the group of individuals that would participate in the pairwise comparison of the impacts. For several reasons it was important that a group be involved in the comparison process rather than individuals. First, the decision making in economic development matters is usually undertaken by a group of individuals. Second, one of the strengths of using the Analytical Hierarchy Process with a group is the discussion that can take place between the participants. This technique allows the focus of the discussion to be on the assumptions which underlie a judgment, rather than the judgment itself (Saaty, 1980).

It was necessary for all the participants to be involved in some manner in economic development in his or her respective county. This gave some assurance that each of the participants would have some knowledge of the county in general, the concerns and goals of the community as a whole, the local economy, constraints that may be facing the county, and what has been done with regard to industrial relocation and expansion in the past. In other words, each participant needed to be considered an “expert” on his or her community.

Ideally, there would be five or six people participating in each county. A list of names of people involved in economic development in each case-study area was originally obtained from a county extension agent (Halifax and Montgomery Counties) or

from the County Administrator's office (Bath County). The names on the original lists were contacted in no particular order. The people who eventually became the participants in the study were those who agreed to participate and whose schedules were free for the meeting time. Again, it should be noted that the preferences obtained from each group are assumed to represent the preferences of the case-study area as a whole, which, in reality, may not be true.

#### *Section 4.1.1: Bath County Participants*

Four people participated in the study in Bath County. Bath County does not have an economic development department. The County Planning Commission and the local Industrial Development Authority (IDA) are the two groups involved in economic development efforts. Although parties from both groups were invited to participate, no members from the IDA attended.

Four members of the Planning Commission did attend. Charles Garratt and Walter Failes are both elected members of the Planning Commission. William McGirr is the chairman of the Planning Commission. The other participant was Darryl Crawford, the Bath County Planner.

#### *Section 4.1.2: Montgomery County Participants*

A diverse group of five individuals agreed to participate in Montgomery County. Ronald Secrist is the town manager of the town of Blacksburg. T.W. "Jay" Johnson is the Chair of the Industrial Attraction Committee, and member of the Montgomery

County Department of Economic Development. Franklyn Moreno is the former Regional Marketing Director of the New River Valley Economic Development Alliance. Henry Jablonski is the Chair of the Montgomery County Board of Supervisors. The final participant was James Stewart, who is the Regional Director for Virginia's Center for Innovative Technology.

#### *Section 4.1.3: Halifax County Participants*

Four people agreed to participate in the study in Halifax County. Still, there was some diversity present in the group. Bill Confroy is the Director of the Halifax IDA. Chris Lumsden and George Whitted are both members of the Halifax County Economic Development Committee. Both of these gentlemen are employed in the private sector. Nancy Pool is with the Chamber of Commerce.

#### **Section 4.2: Preference Ranking Presentation and Comparison Process**

Saaty and Kearns (1985) suggest that researchers unfamiliar with the AHP and with conducting group surveys pre-test their presentation and methods. This pre-test refines the techniques and helps to identify possible problem areas. A pre-test of the presentation was given in the form of a seminar to faculty and students in the Department of Agricultural and Applied Economics (Cox, 1996). During the seminar several helpful suggestions were given. The meeting technique was refined in accordance with the experiences from the seminar.



The participants in each case study area were given a short presentation outlining the objectives and general methods used in this research. The Analytical Hierarchy Process was introduced as the method with which firm impacts were to be compared with one another and that from the rankings, the importance or weight of each impact could be calculated. The pairwise comparison exercise was started after the industry impacts and the scale of relative importance were introduced and explained.

The participants were asked to consider every possible combination of two impacts, “When comparing impact A to impact B, how important of a consideration was one over the other with respect to the attractiveness of an industry?” A person was randomly chosen to be the first to give his or her judgment, using the scale of relative importance. Each additional participant responded at will. If there was immediate consensus, that judgment was entered into the judgment matrix. If not, a discussion of the assumptions or considerations each individual used when making his or her value judgment ensued. At the end of the discussions, a person would be convinced enough to change his judgment or the group would agree on a compromise.

If the group could not come to a consensus with regard to a judgment, the average of each individual’s judgment was taken and used in the judgment matrix. In addition, a vote would also be taken, with a simple majority determining the judgment. The judgments resulting from a vote would be calculated at a later date and compared with the judgments that were determined by taking the average.

#### *Section 4.2.1: Calculation and Re-evaluation of the Comparison Matrix*

When the initial judgment matrix was filled, the priority outcomes were calculated as described in Chapter 3, using a program written in Gauss (Aptech Systems, Inc., 1993). The consistency index and the consistency ratio were also calculated. If the consistency ratio was above the threshold of .20, the judgment matrix was re-examined during the interview.

To reexamine the judgment matrix, the ranking and weights calculated for each impact were presented to the group. The initial step in reevaluation of the matrix was to determine which ranking or weight calculated for an impact did not make sense or was surprising to the participants. This would lead the group's attention to inconsistencies in their value judgments. This process allowed the participants to rethink their judgments and further discuss the assumptions behind the judgments. When a value judgment was revised, the new judgment value (from the scale of relative importance) was entered into the judgment matrix. The matrix was then reevaluated. This process was repeated until the consistency ratio was lower than .20 and the participants were satisfied that the ranking and weight of each impact adequately represented the group's preferences.

#### **Section 4.3: Initial Industrial Targeting Index**

As would be expected, the variety and number of sectors located in each of the case study areas were much less than in the state as a whole. The procedure outlined in Section 3.6 was used with IMPLAN to create "shadow" sectors for those missing from the local economy. Of the 459 sectors in Virginia, 109 were eliminated because the firms

in those sectors are not footloose or were unattractive because of environmental reasons (Table 4-1). Non-footloose sectors include those that are factor-oriented and those that are market-oriented. The factor-dependent sectors mainly consist of sectors in agriculture or mining. The market-oriented sectors mainly include the retail and services sectors.

For Bath County, 263 sectors were added to the model in order for each of the 350 sectors located in Virginia to be represented. Montgomery county has the highest number of industries in its economy of the three case-study areas, with 145 sectors present, needing only 205 sectors added. The model for Halifax County needed 232 sectors added.

Following elimination of the non-footloose sectors, each I/O model had 350 sectors left for consideration. The sectors were ordered, from largest to smallest, using the total value-added effect as the criterion. The total value-added effect is the sum of the local employee compensation, indirect business taxes, proprietary income, and other property income per dollar of output in the sector under consideration. Only the top 100 firms in each county were included for further examination (Table 4-2, Table 4-3, and Table 4-4).

For each county, many of the 100 industries with a large value-added effect are those industries that were added to the model using Virginia data. Not surprisingly then is the similarity of the initial set of industries for each county. The initial set of industries for each county are similar because of the common data added to each model. For example, sixteen of the top twenty sectors in Montgomery County are in the top twenty

**Table 4-1: Sectors Eliminated from Targeting Consideration for Bath, Montgomery, and Halifax Counties**

Implan Code	Sector Title	Reason Eliminated		
		Factor Dependent	Market Oriented	Not Attractive
1	Dairy Farm Products	X		
2	Poultry And Eggs	X		
3	Ranch Fed Cattle	X		
4	Range Fed Cattle	X		
5	Cattle Feedlots	X		
6	Sheep, Lambs And Goats	X		
7	Hogs, Pigs And Swine	X		
8	Other Meat Animal Products	X		
9	Miscellaneous Livestock	X		
10	Cotton	X		
11	Food Grains	X		
12	Feed Grains	X		
13	Hay And Pasture	X		
14	Grass Seeds	X		
15	Tobacco	X		
16	Fruits	X		
17	Tree Nuts	X		
18	Vegetables	X		
21	Oil Bearing Crops	X		
22	Forest Products	X		
24	Forestry Products	X		
25	Commercial Fishing	X		
26	Agricultural, Forestry, Fishery	X		
27	Landscape & Horticultural Services	X		
28	Iron Ores	X		
37	Coal Mining	X		
40	Dimension Stone	X		
41	Sand And Gravel	X		
42	Clay, Ceramic, Refractory Minerals	X		
46	Nonmetallic Minerals	X		
47	Misc. Nonmetallic Minerals, N.E.C.	X		
53	New Mineral Extraction Facilities	X		
63	Condensed And Evaporated Milk	X		
64	Ice Cream And Frozen Desserts	X		
65	Fluid Milk	X		
72	Flour And Other Grain Mill Products	X		
75	Blended And Prepared Flour	X		
76	Wet Corn Milling	X		
133	Logging Camps And Logging Contractors	X		
134	Sawmills And Planing Mills, General	X		
162	Paper Mills, Except Building Paper			X
163	Paperboard Mills			X
249	Asbestos Products			X
268	Aluminum Foundries			X
312	Mining Machinery, Except Oil Field	X		
392	Ship Building And Repairing	X		
393	Boat Building And Repairing	X		
434	Local, Interurban Passenger Transit	X		
448	Building Materials & Gardening		X	
449	General Merchandise Stores		X	
450	Food Stores		X	
451	Automotive Dealers & Service Stations		X	
452	Apparel & Accessory Stores		X	
453	Furniture & Home Furnishings Stores		X	
454	Eating & Drinking		X	

**Table 4-1: Sectors Eliminated from Targeting Consideration for Bath, Montgomery, and Halifax Counties (Continued)**

Implan Code	Sector Title	Reason Eliminated		
		Factor Dependent	Market Oriented	Not Attractive
455	Miscellaneous Retail		X	
456	Banking		X	
457	Credit Agencies		X	
458	Security And Commodity Brokers		X	
460	Insurance Agents And Brokers		X	
461	Owner-occupied Dwellings		X	
462	Real Estate		X	
463	Hotels And Lodging Places		X	
464	Laundry, Cleaning And Shoe Repair		X	
465	Portrait And Photographic Studios		X	
466	Beauty And Barber Shops		X	
467	Funeral Service And Crematories		X	
468	Miscellaneous Personal Services		X	
471	Photofinishing, Commercial Photography		X	
472	Services To Buildings		X	
473	Equipment Rental And Leasing		X	
474	Personnel Supply Services		X	
476	Detective And Protective Services		X	
477	Automobile Rental And Leasing		X	
478	Automobile Parking And Car Wash		X	
479	Automobile Repair And Services		X	
480	Electrical Repair Service		X	
481	Watch, Clock, Jewelry And Furniture		X	
482	Miscellaneous Repair Shops		X	
483	Motion Pictures		X	
484	Theatrical Producers, Bands Etc.		X	
485	Bowling Alleys And Pool Halls		X	
486	Commercial Sports Except Racing		X	
487	Racing And Track Operation		X	
488	Amusement And Recreation Services		X	
489	Membership Sports And Recreation		X	
490	Doctors And Dentists		X	
491	Nursing And Protective Care		X	
492	Hospitals		X	
493	Other Medical And Health Services		X	
494	Legal Services		X	
495	Elementary And Secondary School		X	
496	Colleges, Universities, Schools		X	
497	Other Educational Services		X	
498	Job Training & Related Service		X	
499	Child Day Care Services		X	
500	Social Services, N.E.C.		X	
501	Residential Care		X	
502	Other Nonprofit Organizations		X	
503	Business Associations		X	
504	Labor And Civic Organizations		X	
505	Religious Organizations		X	
506	Engineering, Architectural Services		X	
507	Accounting, Auditing And Bookkeeping		X	
508	Management And Consulting Services		X	
510	Local Government Passenger Transit		X	
519	Federal Government - Military		X	
522	State & Local Government - Education		X	
525	Household Industry-low Income		X	

**Table 4 - 2: Initial Sector Ranking for Bath County**

Initial Rank	IMPLAN Code	Sector Title	Total Value Added Effect
1	191	Plastics Materials And Resins	2.6761
2	109	Narrow Fabric Mills	2.0913
3	523	State & Local Government - Non-Educational	1.3026
4	57	Maintenance And Repair Oil And Gas Wells	1.1702
5	520	Federal Government - Non-military	1.1401
6	352	Fluid Power Pumps & Motors	1.1166
7	371	Phonograph Records And Tape	1.1034
8	113	Knit Underwear Mills	1.0959
9	424	Marking Devices	1.0527
10	270	Nonferrous Castings, N.E.C.	1.0414
11	447	Wholesale Trade	1.0206
12	469	Advertising	1.0166
13	509	Research, Development & Testing	0.9992
14	470	Other Business Services	0.9860
15	129	Pleating And Stitching	0.9824
16	94	Distilled Liquor, Except Brandy	0.9805
17	439	Arrangement Of Passenger Transport	0.9595
18	320	Industrial Patterns	0.9565
19	402	Automatic Temperature Controls	0.9452
20	132	Fabricated Textile Products, N.E.C.	0.9206
21	475	Computer And Data Processing Services	0.9108
22	441	Communications, Except Radio And TV	0.9074
23	438	Pipe Lines, Except Natural Gas	0.9011
24	101	Manufactured Ice	0.8988
25	513	U.S. Postal Service	0.8909
26	183	Bookbinding & Related	0.8830
27	187	Industrial Gases	0.8796
28	136	Special Product Sawmills, N.E.C.	0.8763
29	298	Ammunition, Except For Small Arms	0.8763
30	184	Typesetting	0.8762
31	321	Special Dies And Tools And Accessories	0.8745
32	222	Footwear Cut Stock	0.8616
33	241	Pottery Products, N.E.C.	0.8610
34	427	Fasteners, Buttons, Needles, Pins	0.8561
35	229	Leather Goods, N.E.C.	0.8447
36	174	Newspapers	0.8339
37	412	Ophthalmic Goods	0.8325
38	135	Hardwood Dimension And Flooring	0.8184
39	295	Plating And Polishing	0.8129
40	152	Wood Tv And Radio Cabinets	0.8116
41	153	Household Furniture, N.E.C.	0.8069
42	58	Meat Packing Plants	0.8044
43	233	Brick And Structural Clay Tile	0.8003
44	224	Shoes, Except Rubber	0.7967
45	339	Electronic Computers	0.7947
46	138	Wood Kitchen Cabinets	0.7941
47	367	Electric Lamps	0.7820
48	154	Wood Office Furniture	0.7803
49	104	Cigarettes	0.7782
50	433	Railroads And Related Services	0.7776

**Table 4 - 2: Initial Sector Ranking for Bath County (Continued)**

Initial Rank	Implan Code	Sector Title	Total Value Added Effect
51	428	Brooms And Brushes	0.7750
52	440	Transportation Services	0.7744
53	147	Wood Products, N.E.C.	0.7742
54	376	Printed Circuit Boards	0.7701
55	418	Musical Instruments	0.7687
56	206	Explosives	0.7678
57	426	Costume Jewelry	0.7617
58	406	Optical Instruments & Lenses	0.7575
59	515	Other Federal Government Enterprises	0.7574
60	419	Dolls	0.7535
61	329	Printing Trades Machinery	0.7534
62	160	Furniture And Fixtures, N.E.C.	0.7483
63	512	Other State And Local Govt Enterprises	0.7374
64	54	New Government Facilities	0.7366
65	404	Instruments To Measure Electricity	0.7364
66	55	Maintenance And Repair, Residential	0.7337
67	275	Cutlery	0.7306
68	178	Miscellaneous Publishing	0.7265
69	319	Machine Tools, Metal Forming Types	0.7194
70	142	Wood Pallets And Skids	0.7177
71	226	Luggage	0.7170
72	318	Machine Tools, Metal Cutting Types	0.7159
73	157	Wood Partitions And Fixtures	0.7146
74	271	Metal Heat Treating	0.7140
75	304	Miscellaneous Fabricated Wire Products	0.7130
76	247	Cut Stone And Stone Products	0.7066
77	128	Canvas Products	0.7056
78	284	Fabricated Plate Work	0.7056
79	79	Bread, Cake, And Related Products	0.7031
80	443	Electric Services	0.7027
81	511	State And Local Electric Utilities	0.7019
82	368	Wiring Devices	0.7018
83	185	Plate Making	0.7004
84	396	Complete Guided Missiles	0.6981
85	381	Engine Electrical Equipment	0.6971
86	141	Wood Containers	0.6965
87	377	Semiconductors And Related Devices	0.6959
88	56	Maintenance And Repair Other Facilities	0.6957
89	259	Iron And Steel Foundries	0.6951
90	359	Relays & Industrial Controls	0.6951
91	375	Electron Tubes	0.6916
92	137	Millwork	0.6898
93	148	Wood Household Furniture	0.6883
94	110	Womens Hosiery, Except Socks	0.6878
95	421	Sporting And Athletic Goods, N.E.C.	0.6857
96	269	Brass, Bronze, And Copper Foundries	0.6846
97	181	Greeting Card Publishing	0.6829
98	330	Food Products Machinery	0.6816
99	124	Apparel Made From Purchased Materials	0.6808
100	299	Small Arms	0.6798

**Table 4 - 3: Initial Sector Ranking for Montgomery County**

Initial Rank	Implan Code	Sector Title	Total Value Added Effect
1	523	State & Local Government - Non-Educational	1.4517
2	469	Advertising	1.3694
3	113	Knit Underwear Mills	1.2447
4	352	Fluid Power Pumps & Motors	1.2241
5	371	Phonograph Records And Tape	1.2048
6	509	Research, Development & Testing	1.1868
7	424	Marking Devices	1.1714
8	520	Federal Government - Non-military	1.1442
9	470	Other Business Services	1.1433
10	23	Greenhouse And Nursery Products	1.1213
11	439	Arrangement Of Passenger Transport	1.0988
12	129	Pleating And Stitching	1.0945
13	447	Wholesale Trade	1.0669
14	320	Industrial Patterns	1.0546
15	513	U.S. Postal Service	1.0329
16	241	Pottery Products, N.E.C.	1.0174
17	475	Computer And Data Processing Services	1.0067
18	402	Automatic Temperature Controls	1.0060
19	174	Newspapers	1.0043
20	183	Bookbinding & Related	0.9916
21	132	Fabricated Textile Products, N.E.C.	0.9896
22	94	Distilled Liquor, Except Brandy	0.9873
23	101	Manufactured Ice	0.9769
24	321	Special Dies And Tools And Accessories	0.9745
25	184	Typesetting	0.9558
26	135	Hardwood Dimension And Flooring	0.9470
27	441	Communications, Except Radio And TV	0.9440
28	427	Fasteners, Buttons, Needles, Pins	0.9331
29	187	Industrial Gases	0.9206
30	298	Ammunition, Except For Small Arms	0.9190
31	412	Ophthalmic Goods	0.9045
32	438	Pipe Lines, Except Natural Gas	0.8991
33	136	Special Product Sawmills, N.E.C.	0.8862
34	295	Plating And Polishing	0.8809
35	426	Costume Jewelry	0.8712
36	233	Brick And Structural Clay Tile	0.8709
37	54	New Government Facilities	0.8705
38	55	Maintenance And Repair, Residential	0.8697
39	419	Dolls	0.8677
40	433	Railroads And Related Services	0.8587
41	142	Wood Pallets And Skids	0.8557
42	229	Leather Goods, N.E.C.	0.8542
43	440	Transportation Services	0.8525
44	152	Wood Tv And Radio Cabinets	0.8448
45	147	Wood Products, N.E.C.	0.8445
46	223	House Slippers	0.8343
47	418	Musical Instruments	0.8340
48	109	Narrow Fabric Mills	0.8333
49	141	Wood Containers	0.8323
50	154	Wood Office Furniture	0.8305



**Table 4-3: Initial Sector Ranking for Montgomery County (Continued)**

Initial Rank	Implan Code	Sector Title	Total Value Added Effect
51	138	Wood Kitchen Cabinets	0.8250
52	435	Motor Freight Transport And Warehousing	0.8199
53	515	Other Federal Government Enterprises	0.8162
54	153	Household Furniture, N.E.C.	0.8122
55	222	Footwear Cut Stock	0.8096
56	428	Brooms And Brushes	0.8087
57	206	Explosives	0.8066
58	512	Other State And Local Govt Enterprises	0.7982
59	329	Printing Trades Machinery	0.7914
60	367	Electric Lamps	0.7884
61	406	Optical Instruments & Lenses	0.7862
62	442	Radio And Tv Broadcasting	0.7849
63	140	Structural Wood Members, N.E.C.	0.7785
64	178	Miscellaneous Publishing	0.7740
65	110	Womens Hosiery, Except Socks	0.7705
66	48	New Residential Structures	0.7675
67	157	Wood Partitions And Fixtures	0.7617
68	443	Electric Services	0.7598
69	376	Printed Circuit Boards	0.7595
70	56	Maintenance And Repair Other Facilities	0.7573
71	137	Millwork	0.7563
72	319	Machine Tools, Metal Forming Types	0.7541
73	49	New Industrial And Commercial Buildings	0.7509
74	339	Electronic Computers	0.7500
75	243	Concrete Products, N.E.C.	0.7496
76	275	Cutlery	0.7486
77	247	Cut Stone And Stone Products	0.7475
78	304	Miscellaneous Fabricated Wire Products	0.7461
79	128	Canvas Products	0.7408
80	318	Machine Tools, Metal Cutting Types	0.7397
81	511	State And Local Electric Utilities	0.7377
82	230	Glass And Glass Products, Exc Containers	0.7364
83	284	Fabricated Plate Work	0.7341
84	79	Bread, Cake, And Related Products	0.7299
85	404	Instruments To Measure Electricity	0.7280
86	160	Furniture And Fixtures, N.E.C.	0.7270
87	459	Insurance Carriers	0.7252
88	271	Metal Heat Treating	0.7222
89	396	Complete Guided Missiles	0.7216
90	148	Wood Household Furniture	0.7176
91	185	Plate Making	0.7173
92	368	Wiring Devices	0.7154
93	253	Nonmetallic Mineral Products, N.E.C.	0.7132
94	330	Food Products Machinery	0.7132
95	182	Blankbooks And Looseleaf Binder	0.7128
96	303	Pipe, Valves, And Pipe Fittings	0.7106
97	259	Iron And Steel Foundries	0.7094
98	181	Greeting Card Publishing	0.7086
99	359	Relays & Industrial Controls	0.7083
100	299	Small Arms	0.7079

**Table 4 - 4: Initial Sector Ranking for Halifax County**

Initial Rank	Implan Code	Sector Title	Total Value Added Effect
1	369	Lighting Fixtures And Equipment	4.3386
2	176	Book Publishing	3.5563
3	368	Wiring Devices	2.7104
4	523	State & Local Government - Non-Educational	1.2789
5	57	Maintenance And Repair Oil And Gas Wells	1.1453
6	352	Fluid Power Pumps & Motors	1.1121
7	470	Other Business Services	1.0983
8	113	Knit Underwear Mills	1.0906
9	371	Phonograph Records And Tape	1.0901
10	520	Federal Government - Non-military	1.0720
11	424	Marking Devices	1.0478
12	270	Nonferrous Castings, N.E.C.	1.0215
13	509	Research, Development & Testing	0.9849
14	447	Wholesale Trade	0.9840
15	469	Advertising	0.9839
16	94	Distilled Liquor, Except Brandy	0.9807
17	439	Arrangement Of Passenger Transport	0.9557
18	320	Industrial Patterns	0.9403
19	129	Pleating And Stitching	0.9303
20	513	U.S. Postal Service	0.9227
21	402	Automatic Temperature Controls	0.9185
22	241	Pottery Products, N.E.C.	0.9105
23	441	Communications, Except Radio And TV	0.8878
24	438	Pipe Lines, Except Natural Gas	0.8874
25	132	Fabricated Textile Products, N.E.C.	0.8867
26	101	Manufactured Ice	0.8809
27	136	Special Product Sawmills, N.E.C.	0.8732
28	298	Ammunition, Except For Small Arms	0.8702
29	187	Industrial Gases	0.8634
30	321	Special Dies And Tools And Accessories	0.8512
31	183	Bookbinding & Related	0.8492
32	184	Typesetting	0.8446
33	427	Fasteners, Buttons, Needles, Pins	0.8372
34	475	Computer And Data Processing Services	0.8363
35	433	Railroads And Related Services	0.8357
36	174	Newspapers	0.8328
37	512	Other State And Local Govt Enterprises	0.8247
38	233	Brick And Structural Clay Tile	0.8070
39	426	Costume Jewellery	0.7877
40	412	Ophthalmic Goods	0.7829
41	152	Wood Tv And Radio Cabinets	0.7811
42	428	Brooms And Brushes	0.7796
43	435	Motor Freight Transport And Warehousing	0.7785
44	295	Plating And Polishing	0.7731
45	154	Wood Office Furniture	0.7580
46	104	Cigarettes	0.7563
47	135	Hardwood Dimension And Flooring	0.7559
48	443	Electric Services	0.7525
49	367	Electric Lamps	0.7469
50	206	Explosives	0.7468

**Table 4 - 4: Initial Sector Ranking for Halifax County (Continued)**

Initial Rank	Implan Code	Sector Title	Total Value Added Effect
51	138	Wood Kitchen Cabinets	0.7454
52	419	Dolls	0.7432
53	418	Musical Instruments	0.7381
54	329	Printing Trades Machinery	0.7353
55	275	Cutlery	0.7345
56	229	Leather Goods, N.E.C.	0.7294
57	406	Optical Instruments & Lenses	0.7285
58	511	State And Local Electric Utilities	0.7274
59	339	Electronic Computers	0.7252
60	178	Miscellaneous Publishing	0.7201
61	153	Household Furniture, N.E.C.	0.7180
62	376	Printed Circuit Boards	0.7168
63	440	Transportation Services	0.7158
64	54	New Government Facilities	0.7136
65	110	Womens Hosiery, Except Socks	0.7076
66	160	Furniture And Fixtures, N.E.C.	0.7069
67	515	Other Federal Government Enterprises	0.7049
68	157	Wood Partitions And Fixtures	0.7047
69	243	Concrete Products, N.E.C.	0.7037
70	109	Narrow Fabric Mills	0.7028
71	79	Bread, Cake, And Related Products	0.7008
72	147	Wood Products, N.E.C.	0.6990
73	131	Schiffi Machine Embroideries	0.6974
74	284	Fabricated Plate Work	0.6968
75	304	Miscellaneous Fabricated Wire Products	0.6951
76	55	Maintenance And Repair, Residential	0.6935
77	319	Machine Tools, Metal Forming Types	0.6932
78	396	Complete Guided Missiles	0.6888
79	250	Minerals, Ground Or Treated	0.6883
80	381	Engine Electrical Equipment	0.6881
81	318	Machine Tools, Metal Cutting Types	0.6809
82	404	Instruments To Measure Electricity	0.6804
83	299	Small Arms	0.6796
84	128	Canvas Products	0.6782
85	354	Industrial Machines N.E.C.	0.6777
86	215	Tires And Inner Tubes	0.6741
87	259	Iron And Steel Foundries	0.6707
88	148	Wood Household Furniture	0.6694
89	269	Brass, Bronze, And Copper Foundries	0.6687
90	303	Pipe, Valves, And Pipe Fittings	0.6644
91	96	Flavoring Extracts And Syrups, N.E.C.	0.6632
92	56	Maintenance And Repair Other Facilities	0.6621
93	181	Greeting Card Publishing	0.6601
94	218	Gaskets, Packing And Sealing Devices	0.6600
95	142	Wood Pallets And Skids	0.6600
96	330	Food Products Machinery	0.6599
97	280	Plumbing Fixture Fittings And Trim	0.6586
98	359	Relays & Industrial Controls	0.6585
99	377	Semiconductors And Related Devices	0.6580
100	185	Plate Making	0.6579

for Bath County. A similar situation exists for the top sectors in Halifax County.

However, the actual ordering of the sectors, as well as the size of the total value-added effect, differ for each county, reflecting the different economic structure of each county.

There are several sectors in Bath and Halifax counties having such large total value-added effects as to deserve mentioning.<sup>1</sup> Lighting Fixtures and Equipment, Book Publishing, and Wiring Devices are three sectors in Halifax County whose total value-added effect are surprisingly large, 4.4, 3.6, and 2.7 respectively. The fourth-largest sector has a value-added effect of 1.3. For Bath County, the top two ranked sectors, Plastics Materials and Resins and the Narrow Fabric Mills, have total value-added effects (2.7 and 2.1, respectively) substantially larger than the third ranked sector's value-added effect (1.3). The large value-added effects may be partially due to interlinkages the top sectors to existing industry. For example, in Bath County, Becova Guild, the light textile manufacturer which produces fiberglass and metal giftware (such as personalized mailboxes and signs) and woven rugs and door mats, makes substantial purchases from the Plastics Materials and Resins and the Narrow Fabric Mills sectors. The top sectors identified for each county also lack prominence in the other case study areas, indicating a possible competitive advantage in the identified sectors for the individual counties.

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<sup>1</sup> With one exception, the large total value-added effects are mainly due to large direct effects. The exception is the Narrow Fabric Mills sector, where the more of the value-added comes from the induced effect.

#### **Section 4.4: Analytical Hierarchy Process Results**

None of the participants in any of the counties had difficulty in stating his or her preference for one impact over another. In fact, the participants were surprisingly comfortable with the idea of using subjective judgments, based on experience, knowledge, and intuition, to obtain a priority ranking of development impacts.

After each participant stated his or her judgment, a discussion ensued where each person's reasoning for his or her judgment was revealed. Throughout the discussion of the results of the analytical hierarchy process the reasons for each judgment, which came to light during the ranking process, are presented. The reasoning for the judgments are those given by the participants in each county, and do not include any interpretation from the researcher.

The Consistency Ratio (CR) for the judgment matrix is also presented for each county. The CR represents the transitivity of preferences and the relative strength of the preferences for the entire judgment matrix. Transitivity of preferences simply means if  $A=B$  and  $B=C$  then  $A=C$ . The relative strength of preferences are an extension of transitivity. For example, if A is two times more preferred than B, and B is two times more preferred than C, then A should be four times more preferred than C, if the preferences are perfectly consistent. Using subjective judgments when ranking subjective criteria, perfect consistency is not going to be achieved. The CR measures the extent to which transitivity and relative strength of preferences hold.

#### *Section 4.4.1: Bath County's AHP Results*

The comparison results from the AHP for Bath County are displayed in Table 4-5. The comparisons include the changes that were made because of the respondents' dissatisfaction with the initial priority calculated for several of the impacts. Specifically, the impacts of population growth impact was initially calculated to be the fifth most important impact, more important than the level of capital investment and the level of utility requirements impacts (Table 4-6). Even though the actual weights assigned to each of the final three impacts were very small and very close to one another, the participants felt the order did not adequately represent their preferences.

In addition, the comparisons needed to be reexamined in order to be within the Consistency Ratio (CR) boundary. The initial comparison process yielded a CR of .2897, which is above the .20 desired threshold (Table 4-6). Several changes were made in the comparison matrix after discussion among the participants. The final CR of the matrix was .1963, just below the CR threshold. It is interesting to note that after the comparisons are reexamined, the weights calculated for each impact change, but they do not change very much. The difference caused by modifying judgments occurs mainly in the CR, making the entire set of judgment more consistent. The participants were satisfied with the results after reexamining the comparisons.

The participants' strong preference for an industry that is very clean is readily apparent just by examining the raw comparisons (Table 4-5). Cleanliness of industry was given extreme importance (9 on the scale of relative importance) over all but one of the

**Table 4-5: Final Comparison Matrix of Impacts, Bath County**

	Number of Jobs	Average Wages or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values
Number of Jobs	1	1/5	1/3	3	5	1/9	1/7
Average Wages or Salary	5	1	3	3	3	1/7	3
Level of Capital Investment	3	1/3	1	1	1/3	1/9	1/4
Impacts of Population Growth	1/3	1/3	1	1	1	1/9	1/2
Level of Utility Requirements	1/5	1/3	3	1	1	1/9	1/3
Cleanliness of Industry	9	7	9	9	9	1	7
Impacts on Property Values	7	1/3	4	2	3	1/7	1

Note: The numbers, taken from the Scale of Relative Importance (Table 3-2, page 49) represent the relative preferences between the criterion for that row and column.

**Table 4-6: Initial and Final Ranking and Weight Calculated for Each Impact,**

**Bath County**

<b>Rank</b>	<b>Impact</b>	<b>Initial Weight</b>	<b>Rank</b>	<b>Impact</b>	<b>Final Weight</b>
1	Cleanliness of Industry	52.0410	1	Cleanliness of Industry	50.8586
2	Average Wage or Salary	17.4880	2	Average Wage or Salary	15.8567
3	Impacts on Property Values	11.5187	3	Impacts on Property Values	13.1669
4	Number of Jobs	5.6459	4	Number of Jobs	6.3369
5	Impacts of Population Growth	4.7577	5	Level of Capital Investment	5.1263
6	Level of Capital Investment	4.5247	6	Level of Utility Requirements	4.7490
7	Level of Utility Requirements	4.0421	7	Impacts of Population Growth	3.9058
	<b>Consistency Ratio</b>	.2897		<b>Consistency Ratio</b>	.1963

Note: Weights were recalculated because respondents were not satisfied with the initial priority weights calculated for each impact. In addition, the CR exceeded the desired limit for the initial set of judgments.



other impacts. The initial weight calculated for this impact was 52 percent. After changes were made to the comparison matrix, the weight given to the cleanliness of industry impact decreased to 51 percent, still making it the most important impact for Bath County to consider when targeting firms. The county's desire to maintain an attractive environment may be partially due to the participant's realization of the county's heavy reliance on the tourism industry. The respondents in the group did concur, though, that if representatives from the Industrial Development Authority had participated in the study more importance may have been given to the other impacts. Short of holding another meeting that included representatives of the IDA, it is impossible to predict alternative weighting schemes.

It is also clear that average wage or salary and the impact on property values impacts are important considerations. This finding is supported by the rank and weight calculated for each of these two impacts, 16 percent and 13 percent, respectively (Table 4-6). Average wage or salary was an important consideration because respondents associated higher pay with a higher quality job. Also, respondents felt that firms paying more contribute more to the economic well being of the of the individual employees as well as to the community as a whole.

The impact on property values was an important consideration because of the possible tax revenues that would result from an increase in property values. Because of the few number of industrial, office, or housing sites available in Bath County, respondents determined that having several industries interested in the area would have a

positive impact on property values. Even if only one firm relocated in Bath County, the additional property tax revenues accruing to the county would be welcome.

Contrary to reports from the popular media, the number of jobs offered by a firm is substantially less important than the cleanliness of the firm and quality of the jobs. The number of jobs impact received a weight of 6 percent from the Bath County participants. The participants reasoned that though their unemployment rate is higher than the state as a whole (16.1 percent versus 6.4 percent), the actual number of people unemployed is small because of their small population. Therefore, it is not essential for a firm to offer a large number of jobs for it to be attractive to Bath County.

The remaining three impacts received low priority weights. The level of capital investment and the level of utility requirements impacts each received a weight of approximately 5 percent. Respondents determined the level of capital investment impact was not as important as some of the other impacts because they felt any firm willing to offer employment in the county would be welcome, no matter the level of capital investment. The level of utility requirements impact also received a relatively low importance ranking because the respondents know the water, sewer, and electricity use in the county are far below capacity.

Finally, the impacts of population growth were considered the least important of all the impacts considered. Population growth received a priority weight of 4 percent. The respondents discussed the situation in the county and determined the schools, roads,

and other county facilities are more than adequate for the current population. Increasing the number of people who would use local facilities is not a concern.

#### *Section 4.4.2: Montgomery County's AHP Results*

The comparison results for Montgomery County are displayed in Table 4-7. The comparisons are the original and final comparisons made by the participants. They did not have to be reexamined because the participants felt the order and weights calculated for the impacts during the first attempt adequately represented their preferences. In addition, the CR from the comparisons is .14, well below the .20 threshold (Table 4-8).

The average wage or salary was the most important consideration when determining the attractiveness of industry for Montgomery County, having a priority weight of 35 percent. The participants felt firms offering higher pay were more attractive for two main reasons. First, the presence of Virginia Tech gives Montgomery County a more-educated work force. Second, it was important to the participants that firms seeking incentives to relocate to the area pay their prospective employees “head of household” type jobs. This preference can also be found in Montgomery County’s general guidelines for the use of incentives (Montgomery Regional Economic Development Commission, 1995).

The cleanliness of industry impact received the second-highest ranking of 24 percent. The respondents spoke realistically about how important the environment is when compared to the other impacts. The group realized the ideal firm should in no way have harmful environmental effects, but as a practical matter, this might not be possible.

**Table 4-7: Final Comparison Matrix of Impacts, Montgomery County**

	Number of Jobs	Average Wages or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values
Number of Jobs	1	1/5	1/4	3	7	1	4/1
Average Wages or Salary	5	1	6	5	7	1	6
Level of Capital Investment	4	1/6	1	3	5	1/3	4
Impacts of Population Growth	1/3	1/5	1/3	1	3	1/4	5
Level of Utility Requirements	1/7	1/7	1/5	1/3	1	1/6	1/5
Cleanliness of Industry	1	1	3	4	8	1	7
Impacts on Property Values	1/4	1/6	1/4	1/5	5	1/7	1

Note: The numbers, taken from the Scale of Relative Importance (Table 3-2, page 49) represent the relative preferences between the criterion for that row and column.

**Table 4-8: Ranking and Weight Calculated for Each Impact, Montgomery County**

<b>Rank</b>	<b>Impact</b>	<b>Final Weight</b>
1	Average Wage or Salary	35.4350
2	Cleanliness of Industry	23.5987
3	Level of Capital Investment	15.5472
4	Number of Jobs	12.2303
5	Impacts of Population Growth	6.9030
6	Impacts on Property Values	4.0435
7	Level of Utility Requirements	2.2429
	<b>Consistency Ratio</b>	.1422

Still, the importance of keeping the environment as clean as possible is reflected in the ranking of impacts. The level of capital investment is the third ranked impact, with a weight of 16 percent. Firms having a large level of capital investment were believed to be less likely to relocate in the future. Also, the participants considered the possible tax revenues accruing to the county with the higher levels of capital investment while they were making the comparisons.

The level of capital investment impact was considered only slightly more important than the number of jobs impact, which received a weight of 12 percent. Ranked fifth by the participants, the relative lack of importance assigned to this impact is contrary to the belief espoused by politicians that communities are only concerned with increasing employment in the county. The participants in the study decided that while total number of jobs is an important consideration, that without the aforementioned impacts (high wages, high capital investment and little pollution) even firms offering a very high number of jobs would not be very attractive.

The impact of population growth was somewhat important to the respondents, primarily because of the increase in traffic along Highway 460, and the resulting congestion occurring in the past several years. This impact did not receive very high consideration, with a weight of 7 percent. The respondents felt, in general, the county's local services and facilities were not being used to their fullest capacity.

The final two impacts, impacts on property values and level of utility requirements, received low priority for two very different reasons. The respondents felt

that the possible tax revenues resulting from changes in property values were important, but because the county has no direct control over how property values are determined, the possible impact on property values was of small import to those involved in the economic development process. On the other hand, for the level of utility requirements impact, the respondents' experience told them that if a firm were interested in Montgomery County, they would not be dismissed because of large utility requirements. The group decided that if a firm had the characteristics discussed earlier that were considered important, the county would expand the capacity of the current sewer and water systems in order to meet the industry's needs.

#### *Section 4.4.3: Halifax County's AHP Results*

Table 4-9 displays the comparisons made by the Halifax County representatives. The respondents felt that the rank and weight calculated for each impact adequately represented their priorities. However, the CR, at .27, is above the desired limit. Unfortunately, due to the two hour time constraint, the difficulty in pinpointing possible inconsistent comparisons causing the high CR, and the respondents' satisfaction with their original comparisons, the matrix was not reexamined. While it is important that the responses be as consistent as possible, exceeding the desired CR limit for the type of problem being addressed in this research is not a huge concern. Setting the limit on the CR at .20 is suggested in the literature, however Saaty (1980) does mention that the desired CR limit set could vary with the type of problem.

The cleanliness of industry impact received the highest rank, with a weight of 49 percent (Table 4-10). The respondents felt the importance of having clean industries outweighed other factors. The participants cited a case where the county worked with a firm to reduce the firm's waste flow as an example of how important environmental considerations are to residents.

The level of capital investment is the second most important impact, with a calculated weight of 23 percent. Next, the participants believe that a higher level of capital investment made by a firm indicates a commitment to staying in the county. Also, the possible tax revenue played a part in the respondents' decisions concerning the level of capital investment.

The average wage or salary was considered the third most important consideration, receiving a weight of 13 percent. The respondents stated that firms offering higher than average pay would be beneficial to the entire community. The number of jobs received a weight of 6 percent. The respondents felt the county had made substantial progress in increasing the actual number of jobs in the area in the past several years. They felt it was time to concentrate less on the quantity of jobs and more on some of the other impacts, such as wages, capital investment, and cleanliness of industry.

The final two impacts considered in this study, level of utility requirements and impact on property values, received relatively low priority rankings--3 percent and 2 percent, respectively. The respondents decided the utility capacity of the county could be expanded if necessary, so this impact was not considered to be very



**Table 4-9: Final Comparison Matrix of Impacts, Halifax County**

	Number of Jobs	Average Wages or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values
Number of Jobs	1	1/5	1/5	5	3	1/9	1
Average Wages or Salary	5	1	1/6	6	8	1/8	7
Level of Capital Investment	5	6	1	7	9	1/7	9
Impacts of Population Growth	1/5	1/6	1/7	1	5	1/9	5
Level of Utility Requirements	1/3	1/8	1/9	1/5	1	1/9	5
Cleanliness of Industry	9	8	7	9	9	1	9
Impacts on Property Values	1	1/7	1/9	1/5	1/5	1/9	1

Note: The numbers, taken from the Scale of Relative Importance (Table 3-2, page 49) represent the relative preferences between the criterion for that row and column.

**Table 4-10: Ranking and Weight Calculated for Each Impact, Halifax County**

<b>Rank</b>	<b>Impact</b>	<b>Final Weight</b>
1	Cleanliness of Industry	49.1874
2	Level of Capital Investment	23.0835
3	Average Wage or Salary	12.6554
4	Number of Jobs	5.6459
5	Impacts of Population Growth	4.5140
6	Level of Utility Requirements	2.8215
7	Impacts on Property Values	2.0923
	<b>Consistency Ratio</b>	0.2653

important. The impact on property values was the least important consideration according to the county's representatives.

#### **Section 4.5: Scoring the Impacts**

With the county-specific weights for each impact calculated using the AHP, the *level* of each impact needed to be calculated. These levels then need to be scored. The scores are later multiplied by the weights to calculate the adjusted score for each industry and the county-specific rankings of industry. The raw scores, the scores before the impact priority vector is incorporated, calculated for each industry and each impact are included in Appendix C.

As presented in Section 3.11, calculations for four of the impacts were relatively straightforward. National data from IMPLAN databases were used to calculate the number of jobs, average wage or salary, level of utility requirements, and the level of capital investment. These impacts levels were determined at the four-digit SIC level. Unfortunately, a lack of data prevented the remaining impacts from being measured at the four-digit SIC level. Instead, the calculations were made using data at the two-digit SIC level for the cleanliness of industry, impact of population growth, and impact on property values impacts (see Section 3.11).

#### **Section 4.6: Target Industry Ranking for Each Case-study Area**

Using several criteria, including public and environmental criteria, can help a locality identify industries that would best help that community achieve its goals. There

are substantial differences in the rank of the industries before and after each community's priorities are applied. The industries identified for targeting in each of the case-study areas are also very different than those identified using just the value-added effect criteria (Tables 4-2, 4-3, and 4-4).

For example, it is interesting to note that the two industries with the highest value-added effects in Bath County, Plastics materials and resins and the Narrow fabric mills, are ranked 95th and 41st, respectively. The three sectors initially identified as promising because of large value-added effects for Halifax County also received low final ranks. The top industries were Lighting fixtures and equipment, Book publishing, and Wiring devices, and received final ranks of 92nd, 58th, and 90th, respectively.

In addition, because of the high priority weight placed on cleanliness of industry in Bath and Halifax Counties, the sectors with low levels of pollution rank the highest. Most of the top twenty industries in both cases are classified as non-manufacturing that use none of the chemical pollutants that were used to measure the cleanliness of each industry. The top-ranked industries for Montgomery County consist of some of the highest-scoring industries for the average wage or salary, the impact considered the most important in the county.

The priority weights calculated for the impacts are applied to the raw scores, the results of which are displayed in Table 4-11, Table 4-12, and Table 4-13 for Bath County, Montgomery County, and Halifax County, respectively. After being ranked, the industry

scores for each county were graphed in order to determine if a natural break in the data exists (Figure 4-1, Figure 4-2, and Figure 4-3).

For Bath County, the first four sectors (pipe lines, railroad and related services, communications, and electric services) score significantly higher than the next highest sector (Table 4-14). This indicates that more resources should be used to attract these sectors. For Montgomery County, there is a large drop in scores after the six highest-scoring sectors (Figure 4-2). The top sectors are pipe lines, electric services, communications, railroad services, electronic computers, and state and local electric utilities (Table 4-15). A similar situation exists for Halifax County (Figure 4-3). The two highest ranked industries, pipe lines and other business services, are significantly higher than the third and subsequently ranked sectors (Table 4-16). As no other large gaps between scores exists for any of the case-study areas, data for the top twenty sectors are presented for each county.

The tables (Table 4-14, 4-15, and 4-16) contain some descriptive information about the top-ranked industries in each county that may be of interest to community members. The average number of jobs data are on a per million dollars in output basis for ease of comparison. Also, because the actual size of a firm varies so much, this measure can be used in the future to calculate the total jobs offered by a firm. The number of jobs widely varies between sectors, while, in general, they have high value-added effects and high wages.

**Table 4-11: Adjusted Scores for Each Industry and Each Impact, Bath County**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES						Total Adjusted Score	
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry		Impacts on Property Values
1	438	Pipe Lines, Except Natural Gas	0.43	13.61	5.13	-0.12	-0.22	0.00	1.04	18.83
2	433	Railroads And Related Services	1.54	14.32	0.95	-0.30	-0.63	0.00	4.07	15.88
3	441	Communications, Except Radio And TV	1.21	11.60	2.78	-0.45	-0.35	0.00	3.18	14.78
4	443	Electric Services	0.56	12.67	3.16	-0.50	-1.43	0.00	2.43	14.45
5	475	Computer And Data Processing Services	2.47	7.91	2.08	-0.01	-0.47	0.00	0.61	11.98
6	54	New Government Facilities	1.98	8.53	1.76	-0.15	-0.20	0.00	6.49	11.91
7	57	Maintenance And Repair Oil And Gas Wells	5.58	5.07	1.47	-0.22	-0.24	0.00	3.56	11.66
8	339	Electronic Computers	1.21	14.88	1.40	-0.19	-0.38	-5.38	1.16	11.54
9	520	Federal Government - Non-military	3.96	11.23	0.00	-3.91	0.00	0.00	6.08	11.28
10	94	Distilled Liquor, Except Brandy	0.38	13.37	0.86	-0.01	-0.49	-2.87	0.15	11.23
11	509	Research, Development & Testing	4.53	6.40	1.15	-0.50	-0.57	0.00	13.17	11.02
12	511	State And Local Electric Utilities	0.74	10.33	3.38	-0.50	-3.30	0.00	2.43	10.63
13	447	Wholesale Trade	2.52	8.45	0.94	-0.11	-1.21	0.00	2.35	10.60
14	470	Other Business Services	3.95	3.91	3.00	-0.01	-0.71	0.00	0.61	10.15
15	439	Arrangement Of Passenger Transportation	4.27	4.78	1.67	-0.09	-0.67	0.00	3.00	9.95
16	440	Transportation Services	2.43	6.82	1.72	-0.09	-1.32	0.00	3.00	9.55
17	523	State & Local Government - Non-educational	6.00	7.41	0.00	-3.91	0.00	0.00	6.08	9.51
18	352	Fluid Power Pumps & Motors	3.37	10.79	0.86	-0.19	-0.04	-5.38	1.16	9.41
19	55	Maintenance And Repair, Residential	2.49	5.55	1.64	-0.15	-0.36	0.00	6.49	9.17
20	513	U.S. Postal Service	3.47	11.07	-0.48	-3.91	-1.53	0.00	6.08	8.62
21	320	Industrial Patterns	2.90	10.37	0.86	-0.19	-0.17	-5.38	1.16	8.39
22	79	Bread, Cake, And Related Products	1.52	7.90	2.35	-0.01	-0.64	-2.87	0.15	8.25
23	329	Printing Trades Machinery	1.84	10.86	1.24	-0.19	-0.21	-5.38	1.16	8.16
24	129	Pleating And Stitching	4.34	4.25	2.20	-0.13	-0.14	-3.10	0.42	7.41
25	113	Knit Underwear Mills	6.34	5.22	0.51	-0.07	-0.16	-4.46	0.22	7.38
26	321	Special Dies And Tools And Accessories	2.78	9.51	0.88	-0.19	-0.45	-5.38	1.16	7.15
27	104	Cigarettes	0.22	15.86	2.42	-1.36	-0.35	-9.96	0.75	6.83
28	318	Machine Tools, Metal Cutting Types	2.05	9.85	0.51	-0.19	-0.58	-5.38	1.16	6.26
29	330	Food Products Machinery	1.79	9.38	1.17	-0.19	-0.59	-5.38	1.16	6.18
30	138	Wood Kitchen Cabinets	2.87	5.22	1.51	-0.01	-0.29	-3.40	0.33	5.91
31	136	Special Product Sawmills, N.E.C.	3.69	4.57	1.08	-0.01	-0.07	-3.40	0.33	5.87
32	128	Canvas Products	3.15	5.35	0.74	-0.13	-0.19	-3.10	0.42	5.81
33	319	Machine Tools, Metal Forming Types	2.06	9.67	0.38	-0.19	-0.80	-5.38	1.16	5.75
34	135	Hardwood Dimension And Flooring	3.64	4.67	1.24	-0.01	-0.40	-3.40	0.33	5.75
35	515	Other Federal Government Enterprises	2.63	5.70	1.52	-3.91	-0.29	0.00	6.08	5.65
36	298	Ammunition, Except For Small Arms	2.48	10.44	1.25	-0.03	-0.30	-8.28	0.17	5.56
37	512	Other State And Local Govt Enterprises	1.47	7.45	2.72	-3.91	-2.43	0.00	6.08	5.31
38	469	Advertising	2.99	0.99	2.53	-0.01	-1.28	0.00	0.61	5.21
39	137	Millwork	2.31	5.92	1.21	-0.01	-0.90	-3.40	0.33	5.15
40	124	Apparel Made From Purchased Materials	3.02	4.44	1.03	-0.13	-0.17	-3.10	0.42	5.08
41	109	Narrow Fabric Mills	3.09	5.76	0.69	-0.07	-0.26	-4.46	0.22	4.76
42	141	Wood Containers	3.22	4.41	0.66	-0.01	-0.14	-3.40	0.33	4.75
43	241	Pottery Products, N.E.C.	4.55	4.42	1.36	-0.01	-0.30	-5.35	0.16	4.68
44	142	Wood Pallets And Skids	3.36	4.02	0.82	-0.01	-0.14	-3.40	0.33	4.66
45	275	Cutlery	1.46	10.04	2.13	-0.03	-0.73	-8.28	0.17	4.59
46	110	Womens Hosiery, Except Socks	3.05	5.72	0.71	-0.07	-0.37	-4.46	0.22	4.58
47	147	Wood Products, N.E.C.	3.25	4.62	1.28	-0.01	-1.40	-3.40	0.33	4.34
48	404	Instruments To Measure Electricity	1.61	11.99	1.08	-0.51	-0.28	-9.61	1.34	4.29
49	419	Dolls	2.89	8.49	0.89	-0.01	-0.08	-7.91	0.09	4.27
50	56	Maintenance And Repair Other Facilities	2.30	0.66	1.67	-0.15	-0.25	0.00	6.49	4.23
51	132	Fabricated Textile Products, N.E.C.	1.73	5.30	0.62	-0.13	-0.25	-3.10	0.42	4.18
52	424	Marking Devices	4.19	6.20	1.75	-0.01	-0.12	-7.91	0.09	4.10
53	247	Cut Stone And Stone Products	3.04	5.76	0.82	-0.01	-0.54	-5.35	0.16	3.73
54	58	Meat Packing Plants	0.52	6.33	-0.32	-0.01	-0.33	-2.87	0.15	3.31
55	427	Fasteners, Buttons, Needles, Pins	3.13	6.93	1.36	-0.01	-0.19	-7.91	0.09	3.31
56	406	Optical Instruments & Lenses	1.94	10.60	0.95	-0.51	-0.25	-9.61	1.34	3.13
57	284	Fabricated Plate Work	2.08	9.03	0.70	-0.03	-0.49	-8.28	0.17	3.01
58	101	Manufactured Ice	3.53	5.29	1.65	-0.01	-4.75	-2.87	0.15	2.85
59	185	Plate Making	1.96	10.43	0.58	-0.06	-0.40	-9.76	0.45	2.76
60	402	Automatic Temperature Controls	3.07	8.81	1.17	-0.51	-0.24	-9.61	1.34	2.69
61	233	Brck And Structural Clay Tile	2.80	5.73	1.81	-0.01	-2.43	-5.35	0.16	2.56
62	299	Small Arms	1.52	8.45	1.24	-0.03	-0.69	-8.28	0.17	2.22
63	428	Brooms And Brushes	2.50	5.58	2.13	-0.01	-0.16	-7.91	0.09	2.14
64	304	Miscellaneous Fabricated Wire Products	2.33	7.47	1.23	-0.03	-0.67	-8.28	0.17	2.06
65	178	Miscellaneous Publishing	1.50	7.94	2.60	-0.06	-0.35	-9.76	0.45	1.88
66	154	Wood Office Furniture	2.69	6.46	1.42	-0.08	-0.24	-8.66	0.99	1.59
67	226	Luggage	2.33	5.66	1.70	-0.01	-0.11	-8.04	0.31	1.53
68	157	Wood Partitions And Fixtures	2.57	7.08	0.88	-0.08	-0.29	-8.66	0.99	1.51
69	418	Musical Instruments	2.94	5.69	1.42	-0.01	-0.67	-7.91	0.09	1.46
70	426	Costume Jewelry	2.97	4.87	1.92	-0.01	-0.40	-7.91	0.09	1.45
71	174	Newspapers	2.73	6.70	2.16	-0.06	-0.40	-9.76	0.45	1.39
72	229	Leather Goods, N.E.C.	3.59	4.76	1.24	-0.01	-0.17	-8.04	0.31	1.38
73	184	Typesetting	3.09	7.25	1.02	-0.06	-0.30	-9.76	0.45	1.24

**Table 4-11: Adjusted Scores for Each Industry and Each Impact, Bath County  
(Continued)**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	ADJUSTED SCORES				Total Adjusted Score
						Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
74	181	Greeting Card Publishing	1.31	7.47	2.60	-0.06	-0.33	-9.76	0.45	1.24
75	152	Wood Tv And Radio Cabinets	3.36	5.84	0.83	-0.08	-0.13	-8.66	0.99	1.16
76	224	Shoes, Except Rubber	3.24	5.08	0.98	-0.01	-0.14	-8.04	0.31	1.11
77	160	Furniture And Fixtures, N.E.C.	1.26	7.31	1.24	-0.08	-0.22	-8.66	0.99	0.85
78	412	Ophthalmic Goods	2.72	7.67	1.27	-0.51	-0.71	-9.61	1.34	0.83
79	421	Sporting And Athletic Goods, N.E.C.	1.95	5.58	1.67	-0.01	-0.60	-7.91	0.09	0.68
80	153	Household Furniture, N.E.C.	3.61	5.46	0.51	-0.08	-0.18	-8.66	0.99	0.67
81	183	Bookbinding & Related	4.10	5.54	0.90	-0.06	-0.38	-9.76	0.45	0.35
82	295	Plating And Polishing	2.86	7.23	0.97	-0.03	-2.58	-8.28	0.17	0.18
83	148	Wood Household Furniture	2.73	5.02	0.86	-0.08	-0.42	-8.66	0.99	-0.54
84	222	Footwear Cut Stock	2.84	5.13	0.82	-0.01	-1.49	-8.04	0.31	-0.74
85	396	Complete Guided Missiles	1.18	14.21	1.37	-0.92	-0.25	-17.04	1.34	-1.45
86	371	Phonograph Records And Tape	2.26	11.62	2.47	-0.27	-0.06	-17.75	0.95	-1.73
87	377	Semiconductors And Related Devices	1.24	12.58	0.99	-0.27	-0.78	-17.75	0.95	-3.99
88	375	Electron Tubes	1.61	10.74	0.82	-0.27	-0.69	-17.75	0.95	-5.54
89	367	Electric Lamps	1.51	9.71	2.13	-0.27	-1.76	-17.75	0.95	-6.43
90	359	Relays & Industrial Controls	1.55	9.59	1.08	-0.27	-0.91	-17.75	0.95	-6.71
91	368	Wiring Devices	1.94	8.39	1.24	-0.27	-0.59	-17.75	0.95	-7.04
92	376	Printed Circuit Boards	2.36	7.57	1.23	-0.27	-0.32	-17.75	0.95	-7.17
93	381	Engine Electrical Equipment	1.69	8.84	0.58	-0.27	-0.93	-17.75	0.95	-7.85
94	187	Industrial Gases	1.48	13.33	1.90	-0.50	-2.15	-23.41	1.73	-9.36
95	191	Plastics Materials And Resins	0.50	12.78	1.20	-0.50	-1.56	-23.41	1.73	-10.98
96	206	Explosives	1.93	9.90	1.34	-0.50	-0.71	-23.41	1.73	-11.45
97	270	Nonferrous Castings, N.E.C.	3.05	9.02	1.10	-0.20	-0.35	-50.86	0.57	-38.24
98	271	Metal Heat Treating	1.45	9.18	1.77	-0.20	-1.54	-50.86	0.57	-40.20
99	259	Iron And Steel Foundries	1.90	9.49	0.84	-0.20	-1.69	-50.86	0.57	-40.53
100	269	Brass, Bronze, And Copper Foundries	2.15	8.31	0.95	-0.20	-1.06	-50.86	0.57	-40.72

**Table 4-12: Adjusted Scores for Each Industry and Each Impact, Montgomery County**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
1	438	Pipe Lines, Except Natural Gas	0.83	32.42	15.55	-0.23	-0.10	0.00	-0.22	48.24
2	443	Electric Services	1.09	30.18	9.57	-1.11	-0.68	0.00	1.36	40.42
3	441	Communications, Except Radio And TV	2.34	27.62	8.42	-0.89	-0.17	0.00	2.20	39.52
4	433	Railroads And Related Services	2.98	34.11	2.88	-0.74	-0.30	0.00	0.54	39.47
5	339	Electronic Computers	2.33	35.44	4.25	-0.26	-0.18	-2.49	-0.17	38.91
6	511	State And Local Electric Utilities	1.42	24.60	10.24	-1.11	-1.56	0.00	1.36	34.95
7	352	Fluid Power Pumps & Motors	6.49	25.71	2.61	-0.26	-0.02	-2.49	-0.17	31.88
8	520	Federal Government - Non-military	7.65	26.74	0.00	-6.90	0.00	0.00	4.35	31.83
9	54	New Government Facilities	3.82	20.31	5.33	-0.36	-0.09	0.00	2.37	31.38
10	396	Complete Guided Missiles	2.27	33.84	4.16	-0.78	-0.12	-7.91	-0.16	31.31
11	509	Research, Development & Testing	8.75	15.25	3.50	-0.70	-0.27	0.00	4.00	30.53
12	329	Printing Trades Machinery	3.54	25.87	3.76	-0.26	-0.10	-2.49	-0.17	30.15
13	320	Industrial Patterns	5.60	24.71	2.59	-0.26	-0.08	-2.49	-0.17	29.90
14	404	Instruments To Measure Electricity	3.12	28.55	3.29	-0.43	-0.13	-4.46	-0.16	29.78
15	442	Radio And Tv Broadcasting	3.05	22.42	2.70	-0.89	-0.43	0.00	2.20	29.05
16	513	U.S. Postal Service	6.69	26.37	-1.45	-6.90	-0.72	0.00	4.35	28.34
17	371	Phonograph Records And Tape	4.36	27.67	7.51	-1.61	-0.03	-8.24	-1.43	28.24
18	187	Industrial Gases	2.86	31.75	5.75	-0.21	-1.02	-10.86	-0.12	28.14
19	447	Wholesale Trade	4.87	20.13	2.84	-0.28	-0.57	0.00	0.71	27.71
20	321	Special Dies And Tools And Accessories	5.37	22.65	2.66	-0.26	-0.21	-2.49	-0.17	27.55
21	406	Optical Instruments & Lenses	3.75	25.24	2.89	-0.43	-0.12	-4.46	-0.16	26.72
22	94	Distilled Liquor, Except Brandy	0.72	31.84	2.60	-3.28	-0.23	-1.33	-3.60	26.72
23	523	State & Local Government - Non-Education	11.59	17.65	0.00	-6.90	0.00	0.00	4.35	26.68
24	330	Food Products Machinery	3.46	22.35	3.53	-0.26	-0.28	-2.49	-0.17	26.14
25	475	Computer And Data Processing Se	4.76	18.84	6.31	-0.74	-0.22	0.00	-3.09	25.86
26	440	Transportation Services	4.68	16.24	5.21	-0.23	-0.63	0.00	0.54	25.82
27	318	Machine Tools, Metal Cutting Types	3.95	23.47	1.54	-0.26	-0.27	-2.49	-0.17	25.77
28	298	Ammunition, Except For Small Arms	4.79	24.86	3.79	-1.23	-0.14	-3.84	-2.48	25.76
29	49	New Industrial And Commercial Buildings	4.44	15.06	4.19	-0.36	-0.13	0.00	2.37	25.58
30	402	Automatic Temperature Controls	5.92	20.99	3.56	-0.43	-0.11	-4.46	-0.16	25.31
31	275	Cutlery	2.81	23.92	6.45	-1.23	-0.34	-3.84	-2.48	25.29
32	459	Insurance Carriers	2.59	23.27	-0.70	-0.28	-0.46	0.00	0.74	25.16
33	512	Other State And Local Govt Enterprises	2.84	17.74	8.25	-6.90	-1.15	0.00	4.35	25.14
34	319	Machine Tools, Metal Forming Types	3.98	23.04	1.16	-0.26	-0.38	-2.49	-0.17	24.89
35	55	Maintenance And Repair, Residential	4.80	13.23	4.97	-0.36	-0.17	0.00	2.37	24.84
36	23	Greenhouse And Nursery Products	7.98	5.40	14.02	-0.18	-0.12	0.00	-2.28	24.82
37	439	Arrangement Of Passenger Transp	8.23	11.38	5.08	-0.23	-0.32	0.00	0.54	24.69
38	185	Plate Making	3.79	24.84	1.76	-0.45	-0.19	-4.53	-1.48	23.73
39	178	Miscellaneous Publishing	2.89	18.92	7.89	-0.45	-0.17	-4.53	-1.48	23.07
40	412	Ophthalmic Goods	5.25	18.28	3.85	-0.43	-0.34	-4.46	-0.16	22.00
41	470	Other Business Services	7.62	9.32	9.11	-0.74	-0.33	0.00	-3.09	21.89
42	181	Greeting Card Publishing	2.53	17.78	7.89	-0.45	-0.16	-4.53	-1.48	21.59
43	419	Dolls	5.58	20.22	2.70	-0.77	-0.04	-3.67	-2.82	21.21
44	174	Newspapers	5.28	15.97	6.56	-0.45	-0.19	-4.53	-1.48	21.16
45	424	Marking Devices	8.09	14.77	5.30	-0.77	-0.06	-3.67	-2.82	20.85
46	515	Other Federal Government Enterprises	5.08	13.56	4.62	-6.90	-0.14	0.00	4.35	20.57
47	367	Electric Lamps	2.92	23.12	6.46	-1.61	-0.83	-8.24	-1.43	20.39
48	79	Bread, Cake, And Related Products	2.94	18.83	7.12	-3.28	-0.30	-1.33	-3.60	20.37
49	284	Fabricated Plate Work	4.02	21.50	2.13	-1.23	-0.23	-3.84	-2.48	19.86
50	206	Explosives	3.72	23.59	4.07	-0.21	-0.34	-10.86	-0.12	19.85
51	184	Typesetting	5.96	17.27	3.09	-0.45	-0.14	-4.53	-1.48	19.71
52	427	Fasteners, Buttons, Needles, Pins	6.03	16.51	4.14	-0.77	-0.09	-3.67	-2.82	19.33
53	182	Blankbooks And Looseleaf Binder	2.58	18.79	4.22	-0.45	-0.11	-4.53	-1.48	19.02
54	299	Small Arms	2.94	20.13	3.75	-1.23	-0.32	-3.84	-2.48	18.95
55	303	Pipe, Valves, And Pipe Fittings	3.87	19.55	3.19	-1.23	-0.24	-3.84	-2.48	18.82
56	230	Glass And Glass Products, Exc Containers	3.75	17.98	4.11	-1.12	-0.66	-2.48	-3.05	18.54
57	304	Miscellaneous Fabricated Wire Products	4.50	17.80	3.74	-1.23	-0.32	-3.84	-2.48	18.17
58	359	Relays & Industrial Controls	3.00	22.84	3.27	-1.61	-0.43	-8.24	-1.43	17.40
59	428	Brooms And Brushes	4.82	13.30	6.45	-0.77	-0.07	-3.67	-2.82	17.24
60	183	Bookbinding & Related	7.91	13.20	2.74	-0.45	-0.18	-4.53	-1.48	17.21
61	154	Wood Office Furniture	5.19	15.38	4.29	-1.39	-0.11	-4.02	-2.28	17.06
62	295	Plating And Polishing	5.53	17.23	2.95	-1.23	-1.22	-3.84	-2.48	16.95
63	140	Structural Wood Members, N.E.C.	5.54	12.42	4.57	-0.76	-0.08	-1.58	-3.21	16.91
64	138	Wood Kitchen Cabinets	5.54	12.42	4.57	-0.76	-0.13	-1.58	-3.21	16.85
65	233	Brck And Structural Clay Tile	5.41	13.65	5.50	-1.12	-1.15	-2.48	-3.05	16.76
66	157	Wood Partitions And Fixtures	4.96	16.87	2.68	-1.39	-0.14	-4.02	-2.28	16.68
67	241	Pottery Products, N.E.C	8.77	10.53	4.12	-1.12	-0.14	-2.48	-3.05	16.64
68	137	Millwork	4.46	14.10	3.67	-0.76	-0.42	-1.58	-3.21	16.27
69	243	Concrete Products, N.E.C.	4.76	14.96	3.54	-1.12	-0.44	-2.48	-3.05	16.17
70	135	Hardwood Dimension And Flooring	7.02	11.12	3.75	-0.76	-0.19	-1.58	-3.21	16.16



**Table 4-12: Adjusted Scores for Each Industry and Each Impact, Montgomery County (Continued)**

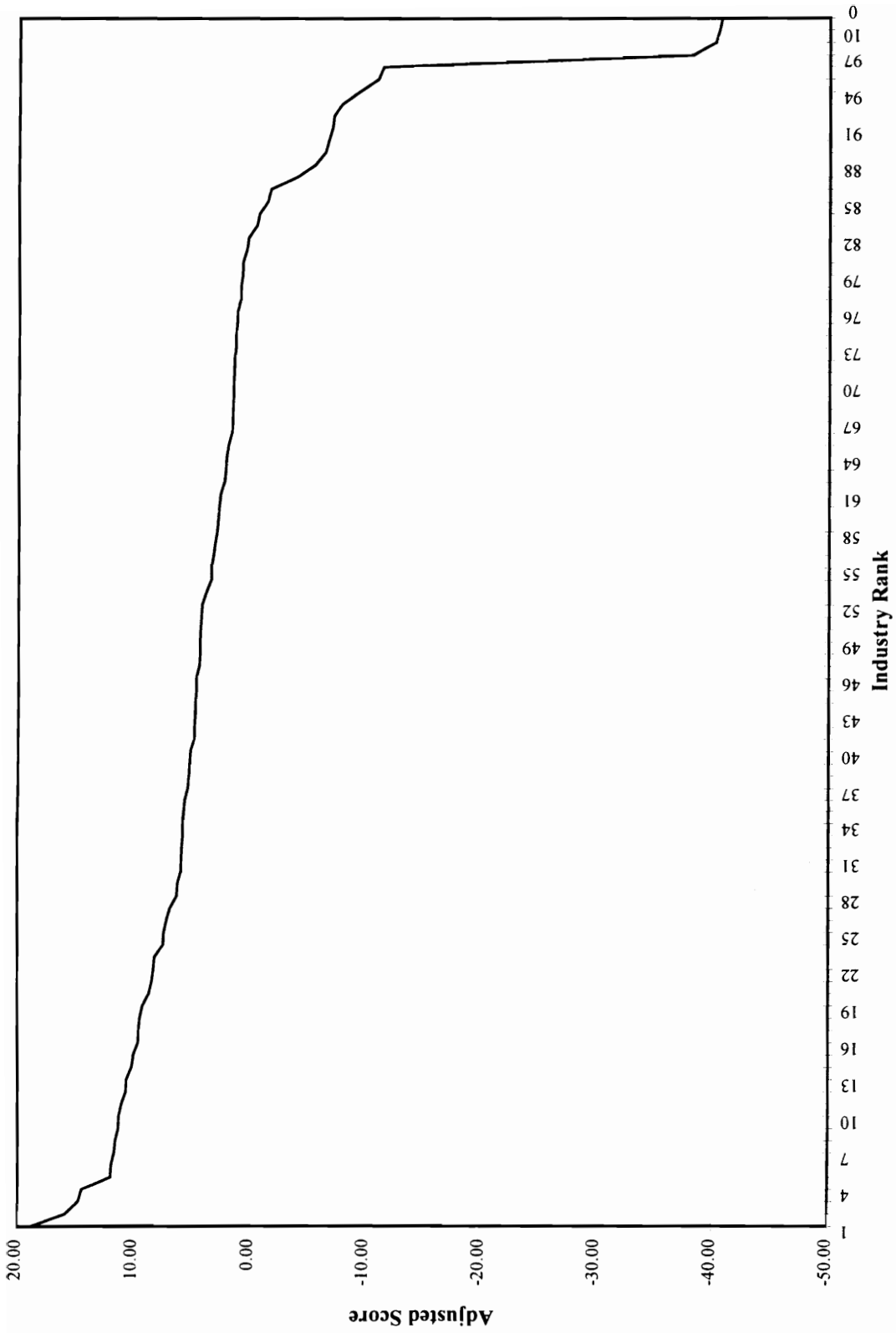
Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
71	253	Nonmetallic Mineral Products, N.E.C.	4.48	14.06	4.60	-1.12	-0.53	-2.48	-3.05	15.96
72	418	Musical Instruments	5.67	13.55	4.29	-0.77	-0.32	-3.67	-2.82	15.95
73	368	Wiring Devices	3.74	19.99	3.77	-1.61	-0.28	-8.24	-1.43	15.94
74	160	Furniture And Fixtures, N.E.C.	2.43	17.41	3.75	-1.39	-0.10	-4.02	-2.28	15.79
75	426	Costume Jewellery	5.74	11.59	5.81	-0.77	-0.19	-3.67	-2.82	15.71
76	136	Special Product Sawmills, N.E.C.	7.13	10.88	3.27	-0.76	-0.03	-1.58	-3.21	15.70
77	247	Cut Stone And Stone Products	5.87	13.72	2.49	-1.12	-0.25	-2.48	-3.05	15.17
78	152	Wood Tv And Radio Cabinets	6.48	13.91	2.52	-1.39	-0.06	-4.02	-2.28	15.16
79	147	Wood Products, N.E.C.	6.27	10.99	3.89	-0.76	-0.66	-1.58	-3.21	14.95
80	376	Printed Circuit Boards	4.56	18.04	3.74	-1.61	-0.15	-8.24	-1.43	14.91
81	129	Pleating And Stitching	8.37	10.12	6.68	-3.32	-0.07	-1.44	-5.55	14.78
82	101	Manufactured Ice	6.81	12.61	5.01	-3.28	-2.24	-1.33	-3.60	13.97
83	153	Household Furniture, N.E.C.	6.97	13.00	1.54	-1.39	-0.08	-4.02	-2.28	13.74
84	113	Knit Underwear Mills	12.23	12.43	1.55	-6.11	-0.08	-2.07	-4.45	13.50
85	141	Wood Containers	6.22	10.51	2.00	-0.76	-0.06	-1.58	-3.21	13.12
86	56	Maintenance And Repair Other Facilities	4.45	1.57	5.06	-0.36	-0.12	0.00	2.37	12.96
87	142	Wood Pallets And Skids	6.49	9.57	2.50	-0.76	-0.07	-1.58	-3.21	12.95
88	229	Leather Goods, N.E.C.	6.92	11.34	3.77	-2.30	-0.08	-3.73	-3.69	12.24
89	48	New Residential Structures	4.62	1.22	4.43	-0.36	-0.16	0.00	2.37	12.12
90	148	Wood Household Furniture	5.27	11.97	2.61	-1.39	-0.20	-4.02	-2.28	11.95
91	223	House Slippers	4.86	11.61	4.67	-2.30	-0.07	-3.73	-3.69	11.37
92	469	Advertising	5.77	2.35	7.68	-0.74	-0.61	0.00	-3.09	11.36
93	128	Canvas Products	6.07	12.75	2.25	-3.32	-0.09	-1.44	-5.55	10.67
94	222	Footwear Cut Stock	5.49	12.22	2.50	-2.30	-0.70	-3.73	-3.69	9.78
95	109	Narrow Fabric Mills	5.96	13.72	2.10	-6.11	-0.12	-2.07	-4.45	9.03
96	110	Womens Hosiery, Except Socks	5.88	13.63	2.14	-6.11	-0.17	-2.07	-4.45	8.85
97	132	Fabricated Textile Products, N.E.C.	3.35	12.62	1.89	-3.32	-0.12	-1.44	-5.55	7.43
98	435	Motor Freight Transport And Warehousing	4.71	1.51	4.46	-0.85	-0.60	0.00	-4.52	4.71
99	271	Metal Heat Treating	2.80	21.86	5.35	-2.95	-0.73	-23.60	-1.90	0.85
100	259	Iron And Steel Foundries	3.66	22.60	2.54	-2.95	-0.80	-23.60	-1.90	-0.44

**Table 4-13: Adjusted Scores for Each Industry and Each Impact, Halifax County**

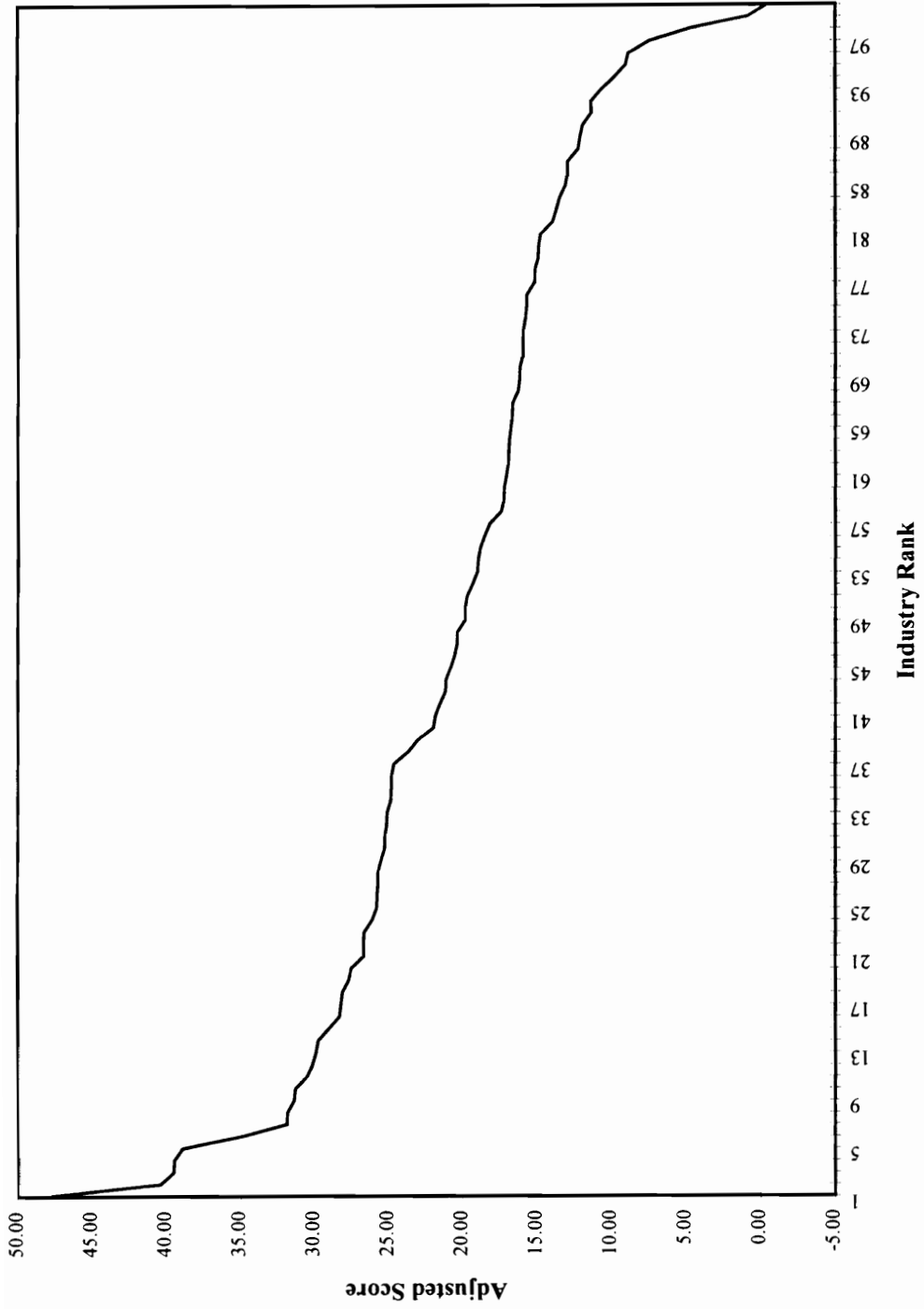
Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES								Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values		
1	438	Pipe Lines, Except Natural Gas	2.23	0.86	23.04	-0.11	-0.13	0.00	1.46	25.88	
2	470	Other Business Services	2.25	7.89	13.49	-0.03	-0.42	0.00	0.54	23.17	
3	57	Maintenance And Repair Oil And Gas Wells	1.76	11.14	6.62	-0.03	-0.14	0.00	2.35	19.34	
4	129	Pleating And Stitching	2.72	8.66	9.89	-0.03	-0.08	-3.00	-0.25	18.15	
5	469	Advertising	0.50	5.97	11.38	-0.03	-0.76	0.00	0.54	17.05	
6	439	Arrangement Of Passenger Transport	1.37	8.52	7.52	-0.11	-0.40	0.00	1.70	16.91	
7	443	Electric Services	2.16	1.12	14.18	-0.14	-0.85	0.00	1.97	16.47	
8	96	Flavoring Extracts And Syrups, N.E.C.	4.97	1.00	13.12	-0.03	-0.19	-2.78	0.38	16.08	
9	509	Research, Development & Testing	2.66	9.05	5.18	-0.63	-0.34	0.00	2.81	15.93	
10	54	New Government Facilities	3.69	3.95	7.90	-0.16	-0.12	0.00	2.29	15.26	
11	475	Computer And Data Processing Services	1.20	4.93	9.35	-0.55	-0.28	0.00	0.54	14.64	
12	441	Communications, Except Radio And TV	0.38	2.42	12.47	-0.63	-0.21	0.00	2.23	14.43	
13	55	Maintenance And Repair, Residential	2.13	4.97	7.37	-0.16	-0.21	0.00	2.29	14.09	
14	56	Maintenance And Repair Other Facilities	2.05	4.60	7.49	-0.26	-0.15	0.00	2.29	13.73	
15	511	State And Local Electric Utilities	3.52	1.47	15.17	-4.51	-1.96	0.00	1.97	13.68	
16	440	Transportation Services	2.17	4.84	7.72	-0.55	-0.79	0.00	1.70	13.40	
17	435	Motor Freight Transport And Warehousing	2.79	4.87	6.61	-0.18	-0.75	0.00	0.08	13.33	
18	135	Hardwood Dimension And Flooring	3.86	7.26	5.56	-0.02	-0.24	-3.29	0.50	13.14	
19	241	Pottery Products, N.E.C.	3.20	9.08	6.11	-0.03	-0.18	-5.17	0.55	13.00	
20	79	Bread, Cake, And Related Products	2.22	3.04	10.56	-0.03	-0.38	-2.78	0.38	12.62	
21	138	Wood Kitchen Cabinets	3.24	5.74	6.77	-0.02	-0.17	-3.29	0.50	12.27	
22	512	Other State And Local Govt Enterprises	2.20	2.94	12.23	-4.51	-1.45	0.00	2.92	11.41	
23	136	Special Product Sawmills, N.E.C.	2.44	7.37	4.85	-0.02	-0.04	-3.29	0.50	11.31	
24	424	Marking Devices	2.43	8.37	7.85	-0.03	-0.07	-7.65	0.63	10.90	
25	113	Knit Underwear Mills	0.20	12.66	2.30	-0.03	-0.10	-4.31	0.10	10.71	
26	523	State & Local Government - Non-Educational	3.09	11.99	0.00	-4.51	0.00	0.00	2.92	10.56	
27	147	Wood Products, N.E.C.	2.56	6.49	5.77	-0.14	-0.83	-3.29	0.50	10.55	
28	131	Schiffli Machine Embroideries	5.65	5.46	2.59	-0.03	-0.22	-3.00	-0.25	10.45	
29	428	Brooms And Brushes	3.73	4.99	9.55	-0.35	-0.09	-7.65	0.63	10.19	
30	433	Railroads And Related Services	2.65	3.08	4.27	0.00	-0.37	0.00	1.70	9.62	
31	142	Wood Pallets And Skids	2.56	6.71	3.70	-0.02	-0.08	-3.29	0.50	9.58	
32	447	Wholesale Trade	1.08	5.04	4.21	-0.03	-0.72	0.00	1.76	9.58	
33	233	Brick And Structural Clay Tile	2.25	5.60	8.15	-0.03	-1.45	-5.17	0.55	9.35	
34	426	Costume Jewelry	2.62	5.94	8.61	-0.03	-0.24	-7.65	0.63	9.26	
35	128	Canvas Products	2.75	6.28	3.33	-0.03	-0.12	-3.00	-0.25	9.21	
36	515	Other Federal Government Enterprises	0.66	5.25	6.85	-4.51	-0.17	0.00	2.92	8.07	
37	101	Manufactured Ice	1.36	7.05	7.42	-2.20	-2.82	-2.78	0.38	8.03	
38	110	Womens Hosiery, Except Socks	3.14	6.09	3.17	0.00	-0.22	-4.31	0.10	7.87	
39	250	Minerals, Ground Or Treated	4.05	3.20	7.11	-0.38	-0.94	-5.17	0.55	7.87	
40	174	Newspapers	2.40	5.46	9.72	-0.11	-0.24	-9.44	1.05	7.80	
41	427	Fasteners, Buttons, Needles, Pins	2.58	6.24	6.13	-0.03	-0.12	-7.65	0.63	7.15	
42	181	Greeting Card Publishing	2.44	2.62	11.69	-0.11	-0.20	-9.44	1.05	7.01	
43	352	Fluid Power Pumps & Motors	1.64	6.72	3.87	-0.29	-0.02	-5.20	1.48	6.71	
44	229	Leather Goods, N.E.C.	1.74	7.17	5.58	-0.03	-0.10	-7.77	0.35	6.58	
45	243	Concrete Products, N.E.C.	1.73	4.92	5.24	-0.03	-0.55	-5.17	0.55	6.14	
46	320	Industrial Patterns	2.08	5.80	3.84	-0.29	-0.10	-5.20	1.48	6.13	
47	178	Miscellaneous Publishing	1.12	2.99	11.69	-0.11	-0.21	-9.44	1.05	6.04	
48	132	Fabricated Textile Products, N.E.C.	2.80	3.46	2.80	-0.02	-0.15	-3.00	-0.25	5.90	
49	275	Cutlery	1.92	2.91	9.56	-0.08	-0.43	-8.01	0.73	5.86	
50	418	Musical Instruments	1.44	5.87	6.36	-0.03	-0.40	-7.65	0.63	5.59	
51	330	Food Products Machinery	2.59	3.58	5.24	-0.29	-0.35	-5.20	1.48	5.56	
52	321	Special Dies And Tools And Accessories	1.82	5.56	3.94	-0.29	-0.27	-5.20	1.48	5.56	
53	154	Wood Office Furniture	2.43	5.37	6.36	-0.14	-0.14	-8.37	0.80	5.51	
54	280	Plumbing Fixture Fittings And Trims	2.72	3.46	7.80	-0.08	-0.41	-8.01	0.73	5.48	
55	339	Electronic Computers	2.48	2.41	6.29	-0.29	-0.23	-5.20	1.48	5.47	
56	329	Printing Trades Machinery	1.84	3.67	5.56	-0.29	-0.12	-5.20	1.48	5.46	
57	109	Narrow Fabric Mills	0.45	6.17	3.11	0.00	-0.15	-4.31	0.10	5.26	
58	176	Book Publishing	2.29	1.96	10.47	-0.11	-0.29	-9.44	1.05	4.88	
59	152	Wood Tv And Radio Cabinets	2.99	6.70	3.74	-0.14	-0.08	-8.37	0.80	4.85	
60	520	Federal Government - Non-military	1.31	7.91	0.00	-4.51	0.00	0.00	2.92	4.71	
61	412	Ophthalmic Goods	2.73	5.44	5.70	-0.03	-0.42	-9.30	1.48	4.12	
62	298	Ammunition, Except For Small Arms	1.54	4.95	5.62	-0.08	-0.18	-8.01	0.73	3.85	
63	183	Bookbinding & Related	1.33	8.18	4.06	-0.11	-0.22	-9.44	1.05	3.81	
64	419	Dolls	1.73	5.77	4.00	-0.03	-0.05	-7.65	0.63	3.78	
65	153	Household Furniture, N.E.C.	2.89	7.21	2.28	-0.14	-0.10	-8.37	0.80	3.77	
66	304	Miscellaneous Fabricated Wire Products	2.21	4.66	5.54	-0.29	-0.40	-8.01	0.73	3.71	
67	354	Industrial Machines N.E.C.	1.60	4.43	3.56	-0.50	-0.19	-5.20	1.48	3.70	
68	94	Distilled Liquor, Except Brandy	2.05	0.75	3.86	-0.03	-0.29	-2.78	0.38	3.55	
69	218	Gaskets, Packing, And Sealing Devices	1.32	3.91	4.70	-0.02	-0.40	-6.00	0.33	3.51	
70	148	Wood Household Furniture	2.87	5.45	3.86	-0.14	-0.25	-8.37	0.80	3.43	

**Table 4-13: Adjusted Scores for Each Industry and Each Impact, Halifax County (Continued)**

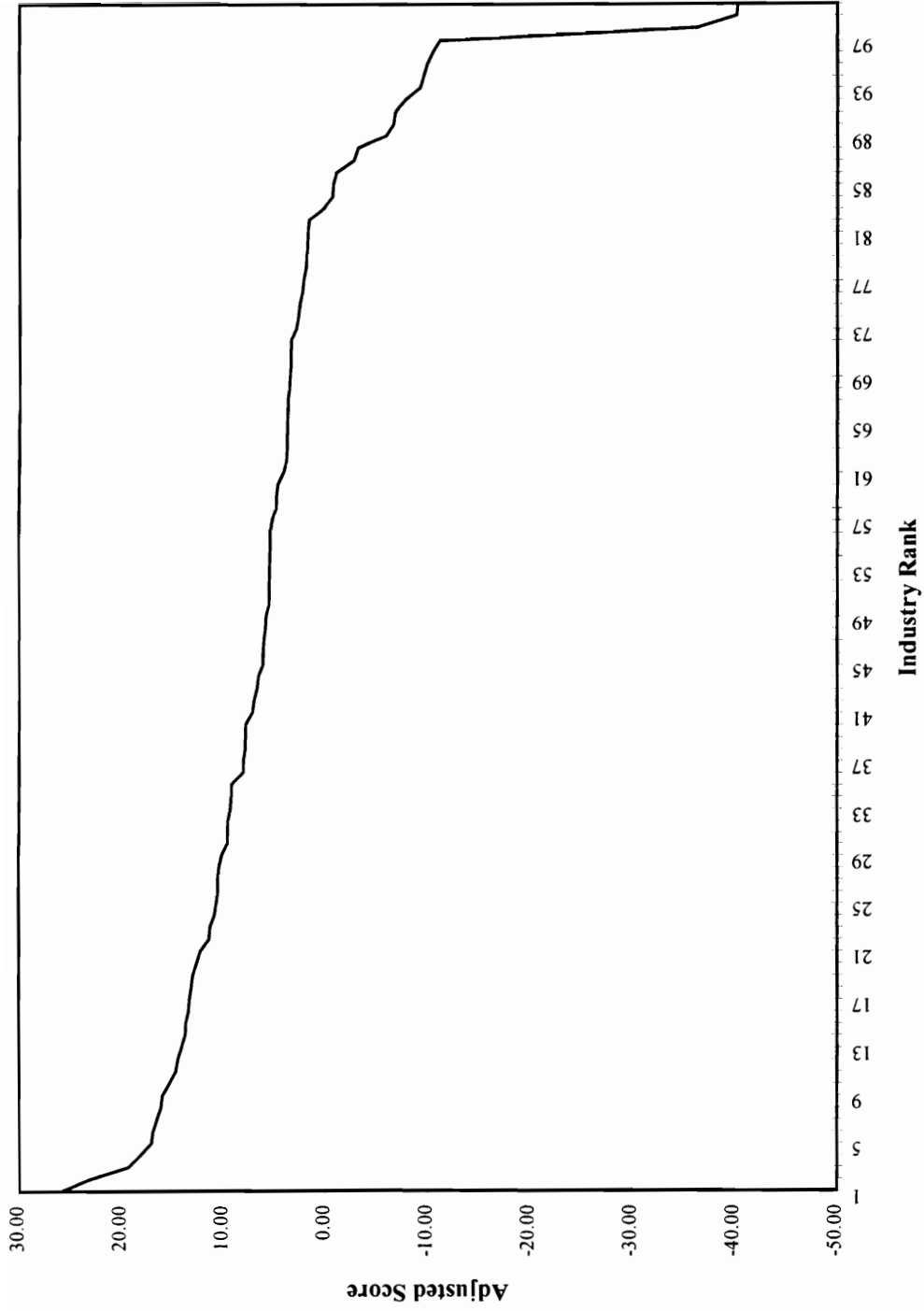
Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES						Impacts on Property Values	Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry		
71	157	Wood Partitions And Fixtures	2.99	5.14	3.97	-0.14	-0.17	-8.37	0.80	3.41
72	513	U.S. Postal Service	4.04	6.93	-2.15	-4.51	-0.91	0.00	2.92	3.39
73	303	Pipe, Valves, And Pipe Fittings	2.55	4.01	4.73	-0.08	-0.30	-8.01	0.73	2.89
74	160	Furniture And Fixtures, N.E.C.	3.22	2.52	5.55	-0.11	-0.13	-8.37	0.80	2.67
75	215	Tires And Inner Tubes	1.75	2.62	4.56	-0.02	-0.37	-6.00	0.33	2.54
76	402	Automatic Temperature Controls	1.10	6.12	5.28	-0.77	-0.14	-9.30	1.48	2.30
77	184	Typesetting	1.17	6.16	4.58	-0.11	-0.18	-9.44	1.05	2.18
78	299	Small Arms	1.85	3.04	5.56	-0.08	-0.41	-8.01	0.73	1.95
79	318	Machine Tools, Metal Cutting Types	1.36	4.09	2.28	-0.29	-0.34	-5.20	1.48	1.90
80	104	Cigarettes	0.33	0.44	10.88	0.00	-0.21	-9.63	1.26	1.81
81	295	Plating And Polishing	1.30	5.72	4.38	-0.08	-1.53	-8.01	0.73	1.77
82	319	Machine Tools, Metal Forming Types	1.79	4.12	1.72	-0.29	-0.47	-5.20	1.48	1.67
83	284	Fabricated Plate Work	1.29	4.16	3.16	-0.08	-0.29	-8.01	0.73	0.22
84	404	Instruments To Measure Electricity	1.50	3.23	4.87	-0.77	-0.17	-9.30	1.48	-0.63
85	371	Phonograph Records And Tape	1.35	4.52	11.12	-0.50	-0.04	-17.17	1.07	-0.72
86	406	Optical Instruments & Lenses	1.05	3.88	4.28	-0.77	-0.15	-9.30	1.48	-1.00
87	185	Plate Making	1.19	3.92	2.60	-0.75	-0.24	-9.44	1.05	-2.70
88	367	Electric Lamps	3.00	3.02	9.56	-0.50	-1.04	-17.17	1.07	-3.13
89	376	Printed Circuit Boards	1.73	4.72	5.55	-0.50	-0.19	-17.17	1.07	-5.86
90	368	Wiring Devices	1.98	3.87	5.59	-0.50	-0.35	-17.17	1.07	-6.58
91	396	Complete Guided Missiles	2.10	2.35	6.17	-0.77	-0.15	-16.48	1.48	-6.77
92	369	Lighting Fixtures And Equipment	1.38	2.96	5.94	-0.50	-0.38	-17.17	1.07	-7.76
93	359	Relays & Industrial Controls	1.08	3.10	4.85	-0.50	-0.54	-17.17	1.07	-9.18
94	187	Industrial Gases	3.65	2.96	8.52	-0.75	-1.28	-22.64	1.49	-9.54
95	377	Semiconductors And Related Devices	1.32	2.47	4.44	-0.50	-0.46	-17.17	1.07	-9.90
96	206	Explosives	2.75	3.85	6.03	-0.02	-0.42	-22.64	1.49	-10.45
97	381	Engine Electrical Equipment	2.01	3.37	2.59	-1.40	-0.55	-17.17	1.07	-11.14
98	270	Nonferrous Castings, N.E.C.	2.07	6.10	4.95	-0.08	-0.21	-49.19	0.92	-36.37
99	269	Brass, Bronze, And Copper Foundries	1.43	4.30	4.26	-0.38	-0.63	-49.19	0.92	-40.22
100	259	Iron And Steel Foundries	2.71	3.79	3.76	-0.38	-1.01	-49.19	0.92	-40.32



**Figure 4-1: Adjusted Score by Industry Rank, Bath County**



**Figure 4-2: Adjusted Score by Industry Rank, Montgomery County**



**Figure 4-3: Adjusted Score by Industry Rank, Halifax County**

**Table 4-14: Top Twenty Industries Identified for Targeting, Bath County**

Rank	IMPLAN Code	SIC Code	Sector Title	Average Number of Jobs (per million output)	Average Wage or Salary (dollars/year)	Value-Added Effect (total value-added/dollar output)
1	438	4600	Pipe Lines, Except Natural Gas	2	\$ 58,113	0.9011
2	433	4010	Railroads And Related Services	8	\$ 61,152	0.7776
3	441	4810	Communications, Except Radio And TV	6	\$ 49,516	0.9074
4	443	4910	Electric Services	3	\$ 54,112	0.7027
5	475	7370	Computer And Data Processing Services	13	\$ 33,780	0.9108
6	54	15,16,17	New Government Facilities	10	\$ 36,410	0.7366
7	57	15,16,17	Maintenance And Repair Oil And Gas Wells	27	\$ 21,658	1.1702
8	339	3571	Electronic Computers	6	\$ 63,525	0.7947
9	520	-	Federal Government - Non-military	21	\$ 47,933	1.1401
10	94	2085	Distilled Liquor, Except Brandy	2	\$ 57,072	0.9805
11	509	8730	Research, Development & Testing	24	\$ 27,336	0.9992
12	511	-	State And Local Electric Utilities	4	\$ 44,098	0.7019
13	447	5000	Wholesale Trade	13	\$ 36,095	1.0206
14	470	7320	Other Business Services	21	\$ 16,709	0.9860
15	439	4720	Arrangement Of Passenger Transportation	22	\$ 20,393	0.9595
16	440	4730	Transportation Services	13	\$ 29,108	0.7744
17	523	-	State & Local Government - Non-educational	32	\$ 31,637	1.3026
18	352	3594	Fluid Power Pumps & Motors	18	\$ 46,088	1.1166
19	55	15,16,17	Maintenance And Repair, Residential	13	\$ 23,717	0.7337
20	513	4311	U.S. Postal Service	18	\$ 42,275	0.8909

**Table 4-15: Top Twenty Industries Identified for Targeting, Montgomery County**

Rank	IMPLAN Code	SIC Code	Sector Title	Average Number of Jobs (per million output)	Average Wage or Salary (dollars/year)	Value-Added Effect (total value-added/dollar output)
1	438	4600	Pipe Lines, Except Natural Gas	2	\$ 58,113	0.8991
2	443	4910	Electric Services	3	\$ 54,112	0.7598
3	441	4810	Communications, Except Radio And TV	6	\$ 49,516	0.9440
4	433	4010	Railroads And Related Services	8	\$ 61,152	0.7598
5	339	3571	Electronic Computers	6	\$ 63,525	0.7500
6	511	-	State And Local Electric Utilities	4	\$ 44,098	0.7377
7	352	3594	Fluid Power Pumps & Motors	18	\$ 46,088	1.2241
8	520	-	Federal Government - Non-military	21	\$ 47,933	1.1442
9	54	15, 16, 17	New Government Facilities	10	\$ 36,410	0.8705
10	396	3761	Complete Guided Missiles	6	\$ 60,669	0.7216
11	509	8730	Research, Development & Testing	24	\$ 27,336	1.1868
12	329	3555	Printing Trades Machinery	10	\$ 46,386	0.7914
13	320	3543	Industrial Patterns	15	\$ 44,296	1.0546
14	404	3825	Instruments To Measure Electricity	9	\$ 51,186	0.7280
15	442	4830	Radio And Tv Broadcasting	8	\$ 40,194	0.7849
16	513	4311	U.S. Postal Service	18	\$ 47,275	1.0329
17	371	3652	Phonograph Records And Tape	12	\$ 49,612	1.2048
18	187	2813	Industrial Gases	8	\$ 56,911	0.9206
19	447	5000	Wholesale Trade	13	\$ 36,095	1.0669
20	321	3544	Special Dies And Tools And Accessories	15	\$ 40,612	0.9745



**Table 4-16: Top Twenty Industries Identified for Targeting, Halifax County**

Rank	IMPLAN Code	SIC Code	Sector Title	Average Number of Jobs (per million output)	Average Wage or Salary (dollars/year)	Value-Added Multiplier (total value-added/dollar output)
1	438	4600	Pipe Lines, Except Natural Gas	2	\$ 58,113	0.8874
2	470	7320	Other Business Services	21	\$ 16,709	1.0983
3	57	1380	Maintenance And Repair Oil And Gas Wells	29	\$ 21,658	1.1453
4	129	2395	Pleating And Stitching	23	\$ 18,134	0.9303
5	469	7310	Advertising	16	\$ 4,209	0.9839
6	439	4720	Arrangement Of Passenger Transport	22	\$ 20,393	0.9557
7	443	4910	Electric Services	3	\$ 54,112	0.7525
8	96	2087	Flavoring Extracts And Syrups, N.E.C.	3	\$ 60,102	0.6632
9	509	8730	Research, Development & Testing	24	\$ 27,336	0.9849
10	54	15, 16, 17	New Government Facilities	10	\$ 36,410	0.7136
11	475	7370	Computer And Data Processing Services	13	\$ 33,780	0.8363
12	441	4810	Communications, Except Radio And TV	6	\$ 49,516	0.8878
13	55	15, 16, 17	Maintenance And Repair, Residential	13	\$ 23,717	0.6935
14	56	15, 16, 17	Maintenance And Repair Other Facilities	12	\$ 2,809	0.6621
15	511	-	State And Local Electric Utilities	4	\$ 44,098	0.7274
16	440	4730	Transportation Services	13	\$ 29,108	0.7158
17	435	4200	Motor Freight Transport And Warehousing	13	\$ 2,712	0.7785
18	135	2426	Hardwood Dimension And Flooring	19	\$ 19,941	0.7559
19	241	3269	Pottery Products, N.E.C.	24	\$ 18,877	0.9105
20	79	2051	Bread, Cake, And Related Products	8	\$ 33,751	0.7008

#### **Section 4.7: Exploration - Results Without the Environmental Consideration**

The prominence of the cleanliness of industry impact and the bias that often occurs when the environment is considered in a study makes it interesting to calculate the weights that would result if the cleanliness of industry impact were not included. In addition, because of the lack of available data on all the sectors and different pollutants, it is interesting to examine how the results change without environmental considerations.

It was anticipated that some of the inconsistency that remains in each comparison matrix will disappear (Table 4-17). The consistency ratio declined for Halifax County, but increased for both Bath and Montgomery Counties. Of course, because of the fewer number of impacts, the weights calculated for each impact increased. However, the order of the impacts did not change at all for any of the three case-study areas. For example, in Bath County, the average wage or salary still ranked higher than the impacts on property values, which in turn still ranked higher than the number of jobs. These weights were applied to the raw or initial industry scores for each of the impacts, excluding the cleanliness of industry. The results are displayed in Table 4-18, Table 4-19, and Table 4-20 for Bath, Montgomery, and Halifax County, respectively.

Without the environmental consideration, the service or government sectors do not hold as prominent a position on the list of industries. Instead, there are more manufacturing sectors with higher wages that rise in the rankings. Still, the rankings did not change much. The new top industries are very similar to the top industries that result when the cleanliness of industry is included, with a somewhat different order.

**Table 4-17: Rank and Weights of Impacts without Cleanliness of Industry, Bath, Montgomery and Halifax Counties**

<b>Impacts</b>	<b>Rank</b>	<b>Weight of Impacts for Bath County</b>	<b>Rank</b>	<b>Weight of Impacts for Montgomery County</b>	<b>Rank</b>	<b>Weight of Impacts for Halifax County</b>
Number of Jobs	3	12.3884	3	13.7746	3	10.5538
Average Wage or Salary	1	33.8827	1	47.9891	2	24.9372
Level of Capital Investment	4	9.9687	2	20.7899	1	48.9137
Impacts of Population Growth	6	7.3159	4	9.2690	4	7.8055
Level of Utility Requirements	5	9.1263	6	2.8188	5	4.4499
Impacts on Property Values	2	27.3180	5	5.3586	6	3.2912
<b>Consistency Ratio</b>		.2402		.1638		.2558

**Table 4-18: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Bath County**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES						Total Adjusted Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Impacts on Property Values	
1	509	Research, Development & Testing	8.8627	13.6797	2.1802	-0.9367	-1.0972	27.3180	50.01
2	433	Railroads And Related Services	3.0142	30.6026	1.7951	-0.5639	-1.2094	8.4344	42.07
3	438	Pipe Lines, Except Natural Gas	0.8393	29.0816	9.6866	-0.2238	-0.4239	2.1675	41.13
4	54	New Government Facilities	3.8715	18.2208	3.3203	-0.2835	-0.3865	13.4739	38.22
5	339	Electronic Computers	2.3628	31.7901	2.6465	-0.3589	-0.7356	2.4051	38.11
6	441	Communications, Except Radio And TV	2.3659	24.7797	5.2443	-0.8458	-0.6733	6.6043	37.48
7	104	Cigarettes	0.4312	33.8827	4.5735	-2.5445	-0.6733	1.5544	37.22
8	520	Federal Government - Non-military	7.7464	23.9872	0.0000	-7.3159	0.0000	12.6156	37.03
9	396	Complete Guided Missiles	2.2988	30.3611	2.5929	-1.7258	-0.4738	2.7857	35.84
10	443	Electric Services	1.1003	27.0796	5.9627	-0.9438	-2.7554	5.0462	35.49
11	371	Phonograph Records And Tape	4.4210	24.8277	4.6760	-0.5099	-0.1247	1.9698	35.26
12	187	Industrial Gases	2.8982	28.4803	3.5817	-0.9411	-4.1393	3.5892	33.47
13	352	Fluid Power Pumps & Motors	6.5789	23.0643	1.6282	-0.3589	-0.0748	2.4051	33.24
14	523	State & Local Government - Non-educational	11.7362	15.8325	0.0000	-7.3159	0.0000	12.6156	32.87
15	55	Maintenance And Repair, Residential	4.8607	11.8687	3.0978	-0.2835	-0.6857	13.4739	32.33
16	404	Instruments To Measure Electricity	3.1572	25.6152	2.0485	-0.9467	-0.5361	2.7857	32.12
17	513	U.S. Postal Service	6.7794	23.6579	-0.9038	-7.3159	-2.9424	12.6156	31.89
18	320	Industrial Patterns	5.6753	22.1674	1.6157	-0.3589	-0.3242	2.4051	31.18
19	377	Semiconductors And Related Devices	2.4182	26.8836	1.8687	-0.5099	-1.4961	1.9698	31.13
20	57	Maintenance And Repair Oil And Gas Wells	10.9021	10.8385	2.7832	-0.4104	-0.4613	7.3811	31.03
21	329	Printing Trades Machinery	3.5894	23.2130	2.3400	-0.3589	-0.3990	2.4051	30.79
22	94	Distilled Liquor, Except Brandy	0.7338	28.5606	1.6223	-0.0133	-0.9475	0.3150	30.27
23	191	Plastics Materials And Resins	0.9812	27.3174	2.2693	-0.9411	-2.9922	3.5892	30.22
24	406	Optical Instruments & Lenses	3.7982	22.6480	1.8016	-0.9467	-0.4738	2.7857	29.61
25	298	Ammunition, Except For Small Arms	4.8481	22.3073	2.3643	-0.0517	-0.5735	0.3524	29.25
26	206	Explosives	3.7698	21.1647	2.5352	-0.9411	-1.3714	3.5892	28.75
27	321	Special Dies And Tools And Accessories	5.4381	20.3238	1.6568	-0.3589	-0.8727	2.4051	28.59
28	402	Automatic Temperature Controls	5.9952	18.8307	2.2196	-0.9467	-0.4613	2.7857	28.42
29	375	Electron Tubes	3.1440	22.9541	1.5428	-0.5099	-1.3216	1.9698	27.78
30	511	State And Local Electric Utilities	1.4378	22.0681	6.3794	-0.9438	-6.3460	5.0462	27.64
31	270	Nonferrous Castings, N.E.C.	5.9675	19.2735	2.0814	-0.3779	-0.6733	1.1796	27.45
32	185	Plate Making	3.8378	22.2839	1.0943	-0.1036	-0.7605	0.9361	27.29
33	275	Cutlery	2.8485	21.4562	4.0193	-0.0517	-1.3964	0.3524	27.23
34	447	Wholesale Trade	4.9323	18.0633	1.7717	-0.2096	-2.3190	4.8730	27.11
35	318	Machine Tools, Metal Cutting Types	4.0026	21.0545	0.9604	-0.3589	-1.1096	2.4051	26.95
36	330	Food Products Machinery	3.5054	20.0475	2.2024	-0.3589	-1.1346	2.4051	26.67
37	439	Arrangement Of Passenger Transportation	8.3394	10.2055	3.1640	-0.1662	-1.2966	6.2152	26.46
38	440	Transportation Services	4.7425	14.5665	3.2466	-0.1662	-2.5434	6.2152	26.06
39	475	Computer And Data Processing Services	4.8238	16.9045	3.9309	-0.0199	-0.8977	1.2671	26.01
40	319	Machine Tools, Metal Forming Types	4.0346	20.6712	0.7250	-0.3589	-1.5335	2.4051	25.94
41	367	Electric Lamps	2.9584	20.7413	4.0221	-0.5099	-3.3787	1.9698	25.80
42	419	Dolls	5.6524	18.1391	1.6838	-0.0138	-0.1621	0.1869	25.49
43	359	Relays & Industrial Controls	3.0374	20.4906	2.0376	-0.5099	-1.7455	1.9698	25.28
44	178	Miscellaneous Publishing	2.9250	16.9751	4.9150	-0.1036	-0.6733	0.9361	24.97
45	515	Other Federal Government Enterprises	5.1415	12.1694	2.8797	-7.3159	-0.5610	12.6156	24.93
46	424	Marking Devices	8.1950	13.2519	3.3028	-0.0138	-0.2369	0.1869	24.69
47	412	Ophthalmic Goods	5.3221	16.3990	2.3985	-0.9467	-1.3714	2.7857	24.59
48	512	Other State And Local Govt Enterprises	2.8805	15.9189	5.1417	-7.3159	-4.6754	12.6156	24.57
49	113	Knit Underwear Mills	12.3884	11.1479	0.9673	-0.1266	-0.3117	0.4499	24.52
50	368	Wiring Devices	3.7904	17.9296	2.3501	-0.5099	-1.1346	1.9698	24.40
51	284	Fabricated Plate Work	4.0676	19.2850	1.3273	-0.0517	-0.9351	0.3524	24.05
52	376	Printed Circuit Boards	4.6166	16.1827	2.3332	-0.5099	-0.6109	1.9698	23.98
53	174	Newspapers	5.3462	14.3263	4.0885	-0.1036	-0.7605	0.9361	23.83
54	184	Typesetting	6.0346	15.4958	1.9256	-0.1036	-0.5860	0.9361	23.70
55	181	Greeting Card Publishing	2.5665	15.9541	4.9173	-0.1036	-0.6359	0.9361	23.63
56	271	Metal Heat Treating	2.8356	19.6114	3.3362	-0.3779	-2.9548	1.1796	23.63
57	79	Bread, Cake, And Related Products	2.9777	16.8900	4.4388	-0.0133	-1.2343	0.3150	23.37
58	427	Fasteners, Buttons, Needles, Pins	6.1116	14.8107	2.5778	-0.0138	-0.3740	0.1869	23.30
59	154	Wood Office Furniture	5.2590	13.7961	2.6746	-0.1485	-0.4613	2.0497	23.17
60	157	Wood Partitions And Fixtures	5.0268	15.1321	1.6700	-0.1485	-0.5610	2.0497	23.17
61	259	Iron And Steel Foundries	3.7085	20.2798	1.5803	-0.3779	-3.2541	1.1796	23.12
62	381	Engine Electrical Equipment	3.2945	18.8887	1.0902	-0.5099	-1.7829	1.9698	22.95
63	269	Brass, Bronze, And Copper Foundries	4.2057	17.7485	1.7911	-0.3779	-2.0447	1.1796	22.50
64	299	Small Arms	2.9780	18.0631	2.3385	-0.0517	-1.3216	0.3524	22.36

**Table 4-18: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Bath County (Continued)**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES					Impacts on Property Values	Total Adjusted Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements		
65	152	Wood Tv And Radio Cabinets	6.5629	12.4779	1.5722	-0.1485	-0.2494	2.0497	22.26
66	129	Pleating And Stitching	8.4769	9.0751	4.1592	-0.2468	-0.2743	0.8725	22.06
67	160	Furniture And Fixtures, N.E.C.	2.4638	15.6201	2.3345	-0.1485	-0.4239	2.0497	21.90
68	304	Miscellaneous Fabricated Wire Products	4.5591	15.9660	2.3307	-0.0517	-1.2842	0.3524	21.87
69	56	Maintenance And Repair Other Facilities	4.5028	1.4056	3.1506	-0.2835	-0.4738	13.4739	21.78
70	183	Bookbinding & Related	8.0075	11.8438	1.7089	-0.1036	-0.7231	0.9361	21.67
71	470	Other Business Services	7.7207	8.3617	5.6734	-0.0199	-1.3590	1.2671	21.64
72	153	Household Furniture, N.E.C.	7.0622	11.6670	0.9568	-0.1485	-0.3366	2.0497	21.25
73	428	Brooms And Brushes	4.8822	11.9334	4.0174	-0.0138	-0.2992	0.1869	20.71
74	241	Pottery Products, N.E.C.	8.8883	9.4465	2.5691	-0.0141	-0.5735	0.3352	20.65
75	226	Luggage	4.5456	12.0945	3.2104	-0.0184	-0.2120	0.6470	20.27
76	229	Leather Goods, N.E.C.	7.0143	10.1768	2.3477	-0.0184	-0.3242	0.6470	19.84
77	138	Wood Kitchen Cabinets	5.6164	11.1446	2.8450	-0.0109	-0.5486	0.6930	19.74
78	136	Special Product Sawmills, N.E.C.	7.2174	9.7609	2.0400	-0.0109	-0.1371	0.6930	19.56
79	109	Narrow Fabric Mills	6.0409	12.3098	1.3070	-0.1266	-0.4987	0.4499	19.48
80	418	Musical Instruments	5.7427	12.1606	2.6753	-0.0138	-1.2966	0.1869	19.46
81	224	Shoes, Except Rubber	6.3363	10.8522	1.8458	-0.0184	-0.2743	0.6470	19.39
82	135	Hardwood Dimension And Flooring	7.1103	9.9790	2.3373	-0.0109	-0.7605	0.6930	19.35
83	426	Costume Jewellery	5.8151	10.4023	3.6224	-0.0138	-0.7605	0.1869	19.25
84	128	Canvas Products	6.1486	11.4404	1.3992	-0.2468	-0.3740	0.8725	19.24
85	110	Womens Hosiery, Except Socks	5.9588	12.2293	1.3350	-0.1266	-0.7107	0.4499	19.14
86	247	Cut Stone And Stone Products	5.9434	12.3105	1.5492	-0.0141	-1.0348	0.3352	19.09
87	148	Wood Household Furniture	5.3338	10.7364	1.6250	-0.1485	-0.7979	2.0497	18.80
88	137	Millwork	4.5220	12.6516	2.2893	-0.0109	-1.7205	0.6930	18.42
89	295	Plating And Polishing	5.6004	15.4590	1.8409	-0.0517	-4.9621	0.3524	18.24
90	421	Sporting And Athletic Goods, N.E.C.	3.8104	11.9196	3.1594	-0.0138	-1.1595	0.1869	17.90
91	124	Apparel Made From Purchased Materials	5.8942	9.4908	1.9395	-0.2468	-0.3242	0.8725	17.63
92	141	Wood Containers	6.2972	9.4267	1.2488	-0.0109	-0.2618	0.6930	17.39
93	142	Wood Pallets And Skids	6.5703	8.5899	1.5565	-0.0109	-0.2743	0.6930	17.12
94	233	Brick And Structural Clay Tile	5.4785	12.2453	3.4287	-0.0141	-4.6754	0.3352	16.80
95	147	Wood Products, N.E.C.	6.3493	9.8618	2.4250	-0.0109	-2.6930	0.6930	16.63
96	132	Fabricated Textile Products, N.E.C.	3.3914	11.3247	1.1766	-0.2468	-0.4738	0.8725	16.04
97	222	Footwear Cut Stock	5.5585	10.9640	1.5549	-0.0184	-2.8676	0.6470	15.84
98	58	Meat Packing Plants	1.0202	13.5204	-0.6120	-0.0133	-0.6359	0.3150	13.59
99	101	Manufactured Ice	6.8967	11.3143	3.1217	-0.0133	-9.1263	0.3150	12.51
100	469	Advertising	5.8448	2.1063	4.7835	-0.0199	-2.4686	1.2671	11.51

**Table 4-19: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Montgomery County**

Rank	IMPLAN Code	Sector Title	ADJUSTED SCORES						Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Impacts on Property Values	
1	438	Pipe Lines, Except Natural Gas	0.93	43.90	20.79	-0.07	-0.13	0.32	65.75
2	433	Railroads And Related Services	3.35	46.20	3.85	-0.91	-0.37	4.23	56.34
3	339	Electronic Computers	2.63	47.99	5.68	-0.05	-0.23	0.16	56.17
4	443	Electric Services	1.22	40.88	12.80	-0.70	-0.85	1.12	54.47
5	396	Complete Guided Missiles	2.56	45.83	5.57	-0.10	-0.15	0.05	53.75
6	187	Industrial Gases	3.22	42.99	7.69	-0.02	-1.28	0.01	52.61
7	371	Phonograph Records And Tape	4.92	37.48	10.04	-0.75	-0.04	0.19	51.83
8	441	Communications, Except Radio And TV	2.63	37.41	11.26	-0.67	-0.21	1.07	51.49
9	511	State And Local Electric Utilities	1.60	33.31	13.69	-0.70	-1.96	1.12	47.06
10	404	Instruments To Measure Electricity	3.51	38.67	4.40	-0.06	-0.17	0.05	46.40
11	352	Fluid Power Pumps & Motors	7.32	34.82	3.49	-0.05	-0.02	0.16	45.71
12	94	Distilled Liquor, Except Brandy	0.82	43.11	3.48	-4.16	-0.29	2.06	45.03
13	298	Ammunition, Except For Small Arms	5.39	33.67	5.07	-1.09	-0.18	1.31	44.19
14	329	Printing Trades Machinery	3.99	35.04	5.02	-0.05	-0.12	0.16	44.04
15	275	Cutlery	3.17	32.39	8.63	-1.09	-0.43	1.31	43.98
16	54	New Government Facilities	4.30	27.51	7.13	-0.54	-0.12	5.36	43.64
17	320	Industrial Patterns	6.31	33.46	3.47	-0.05	-0.10	0.16	43.24
18	406	Optical Instruments & Lenses	4.22	34.19	3.87	-0.06	-0.15	0.05	42.12
19	367	Electric Lamps	3.29	31.31	8.63	-0.75	-1.04	0.19	41.63
20	206	Explosives	4.19	31.95	5.44	-0.02	-0.42	0.01	41.15
21	185	Plate Making	4.27	33.64	2.35	-0.25	-0.23	0.40	40.16
22	321	Special Dies And Tools And Accessories	6.05	30.68	3.56	-0.05	-0.27	0.16	40.12
23	402	Automatic Temperature Controls	6.67	28.43	4.76	-0.06	-0.14	0.05	39.70
24	520	Federal Government - Non-military	8.61	36.21	0.00	-6.81	0.00	1.42	39.44
25	178	Miscellaneous Publishing	3.25	25.62	10.55	-0.25	-0.21	0.40	39.36
26	475	Computer And Data Processing Se	5.36	25.52	8.44	-0.74	-0.28	0.80	39.10
27	330	Food Products Machinery	3.90	30.26	4.73	-0.05	-0.35	0.16	38.64
28	271	Metal Heat Treating	3.15	29.60	7.16	-2.12	-0.91	1.66	38.55
29	509	Research, Development & Testing	9.85	20.65	4.68	-1.13	-0.34	4.39	38.10
30	318	Machine Tools, Metal Cutting Types	4.45	31.78	2.06	-0.05	-0.34	0.16	38.06
31	419	Dolls	6.28	27.38	3.61	-0.77	-0.05	1.38	37.84
32	359	Relays & Industrial Controls	3.38	30.93	4.37	-0.75	-0.54	0.19	37.59
33	447	Wholesale Trade	5.48	27.27	3.80	-0.22	-0.72	1.88	37.50
34	181	Greeting Card Publishing	2.85	24.08	10.55	-0.25	-0.20	0.40	37.44
35	442	Radio And Tv Broadcasting	3.44	30.36	3.61	-0.67	-0.54	1.07	37.27
36	319	Machine Tools, Metal Forming Types	4.49	31.20	1.56	-0.05	-0.47	0.16	36.88
37	424	Marking Devices	9.11	20.00	7.09	-0.77	-0.07	1.38	36.74
38	259	Iron And Steel Foundries	4.12	30.61	3.39	-2.12	-1.01	1.66	36.67
39	284	Fabricated Plate Work	4.52	29.11	2.85	-1.09	-0.29	1.31	36.42
40	174	Newspapers	5.94	21.63	8.77	-0.25	-0.23	0.40	36.26
41	23	Greenhouse And Nursery Products	8.99	7.31	18.75	-0.15	-0.15	1.45	36.21
42	440	Transportation Services	5.27	21.99	6.97	-0.23	-0.79	2.94	36.16
43	79	Bread, Cake, And Related Products	3.31	25.50	9.53	-4.16	-0.38	2.06	35.86
44	49	New Industrial And Commercial Buildings	5.00	20.39	5.61	-0.54	-0.16	5.36	35.67
45	299	Small Arms	3.31	27.27	5.02	-1.09	-0.41	1.31	35.42
46	368	Wiring Devices	4.21	27.07	5.04	-0.75	-0.35	0.19	35.42
47	412	Ophthalmic Goods	5.92	24.76	5.15	-0.06	-0.42	0.05	35.39
48	427	Fasteners, Buttons, Needles, Pins	6.80	22.36	5.53	-0.77	-0.12	1.38	35.18
49	303	Pipe, Valves, And Pipe Fittings	4.36	26.47	4.27	-1.09	-0.30	1.31	35.03
50	513	U.S. Postal Service	7.54	35.71	-1.94	-6.81	-0.91	1.42	35.02
51	55	Maintenance And Repair, Residential	5.40	17.92	6.65	-0.54	-0.21	5.36	34.58
52	184	Typesetting	6.71	23.39	4.13	-0.25	-0.18	0.40	34.20
53	182	Blankbooks And Looseleaf Binder	2.91	25.45	5.64	-0.25	-0.14	0.40	34.01
54	304	Miscellaneous Fabricated Wire Products	5.07	24.10	5.00	-1.09	-0.40	1.31	34.00
55	376	Printed Circuit Boards	5.13	24.43	5.01	-0.75	-0.19	0.19	33.82
56	230	Glass And Glass Products, Exc Containers	4.23	24.35	5.50	-1.21	-0.83	1.75	33.79
57	439	Arrangement Of Passenger Transp	9.27	15.41	6.79	-0.23	-0.40	2.94	33.78
58	154	Wood Office Furniture	5.85	20.83	5.74	-1.15	-0.14	2.61	33.73
59	157	Wood Partitions And Fixtures	5.59	22.84	3.58	-1.15	-0.17	2.61	33.30
60	470	Other Business Services	8.58	12.62	12.18	-0.74	-0.42	0.80	33.02
61	459	Insurance Carriers	2.92	31.51	-0.93	-0.06	-0.58	0.09	32.95
62	160	Furniture And Fixtures, N.E.C.	2.74	23.58	5.01	-1.15	-0.13	2.61	32.66
63	428	Brooms And Brushes	5.43	18.01	8.62	-0.77	-0.09	1.38	32.58

**Table 4-19: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Montgomery County (Continued)**

Rank	IMPLAN Code	Sector Title	ADJUSTED SCORES						Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Impacts on Property Values	
64	295	Plating And Polishing	6.23	23.34	3.95	-1.09	-1.53	1.31	32.21
65	523	State & Local Government - Non-Education	13.05	23.90	0.00	-6.81	0.00	1.42	31.57
66	512	Other State And Local Govt Enterprises	3.20	24.03	11.04	-6.81	-1.44	1.42	31.44
67	233	Brick And Structural Clay Tile	6.09	18.49	7.36	-1.21	-1.44	1.75	31.04
68	152	Wood Tv And Radio Cabinets	7.30	18.84	3.37	-1.15	-0.08	2.61	30.89
69	418	Musical Instruments	6.39	18.36	5.74	-0.77	-0.40	1.38	30.69
70	140	Structural Wood Members, N.E.C.	6.24	16.82	6.11	-0.85	-0.10	2.21	30.43
71	183	Bookbinding & Related	8.90	17.88	3.67	-0.25	-0.22	0.40	30.37
72	138	Wood Kitchen Cabinets	6.24	16.82	6.11	-0.85	-0.17	2.21	30.36
73	243	Concrete Products, N.E.C.	5.36	20.26	4.73	-1.21	-0.55	1.75	30.35
74	426	Costume Jewellery	6.47	15.70	7.77	-0.77	-0.23	1.38	30.32
75	253	Nonmetallic Mineral Products, N.E.C.	5.04	19.05	6.15	-1.21	-0.67	1.75	30.11
76	241	Pottery Products, N.E.C.	9.88	14.26	5.51	-1.21	-0.18	1.75	30.03
77	137	Millwork	5.03	19.10	4.91	-0.85	-0.53	2.21	29.87
78	135	Hardwood Dimension And Flooring	7.91	15.06	5.02	-0.85	-0.23	2.21	29.11
79	153	Household Furniture, N.E.C.	7.85	17.61	2.05	-1.15	-0.10	2.61	28.87
80	129	Pleating And Stitcing	9.43	13.70	8.93	-6.19	-0.08	3.05	28.82
81	247	Cut Stone And Stone Products	6.61	18.58	3.32	-1.21	-0.32	1.75	28.74
82	136	Special Product Sawmills, N.E.C.	8.03	14.73	4.38	-0.85	-0.04	2.21	28.45
83	147	Wood Products, N.E.C.	7.06	14.89	5.20	-0.85	-0.83	2.21	27.68
84	229	Leather Goods, N.E.C.	7.80	15.36	5.04	-2.97	-0.10	2.43	27.57
85	148	Wood Household Furniture	5.93	16.21	3.49	-1.15	-0.25	2.61	26.84
86	223	House Slippers	5.48	15.73	6.25	-2.97	-0.08	2.43	26.83
87	101	Manufactured Ice	7.67	17.08	6.70	-4.16	-2.82	2.06	26.54
88	113	Knit Underwear Mills	13.77	16.83	2.08	-9.27	-0.10	2.55	25.87
89	141	Wood Containers	7.00	14.23	2.68	-0.85	-0.08	2.21	25.19
90	142	Wood Pallets And Skids	7.31	12.97	3.34	-0.85	-0.08	2.21	24.89
91	515	Other Federal Government Enterprises	5.72	18.37	6.18	-6.81	-0.17	1.42	24.71
92	222	Footwear Cut Stock	6.18	16.55	3.34	-2.97	-0.89	2.43	24.65
93	128	Canvas Products	6.84	17.27	3.00	-6.19	-0.12	3.05	23.85
94	109	Narrow Fabric Mills	6.72	18.58	2.81	-9.27	-0.15	2.55	21.23
95	110	Womens Hosiery, Except Socks	6.63	18.46	2.87	-9.27	-0.22	2.55	21.02
96	132	Fabricated Textile Products, N.E.C.	3.77	17.10	2.53	-6.19	-0.15	3.05	20.10
97	469	Advertising	6.50	3.18	10.27	-0.74	-0.76	0.80	19.24
98	56	Maintenance And Repair Other Facilities	5.01	2.12	6.76	-0.54	-0.15	5.36	18.57
99	48	New Residential Structures	5.20	1.65	5.92	-0.54	-0.20	5.36	17.40
100	435	Motor Freight Transport And Warehousing	5.30	2.05	5.97	-1.30	-0.75	2.41	13.67

**Table 4-20: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Halifax County**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES					Impacts on Property Values	Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements		
1	438	Pipe Lines, Except Natural Gas	4.16	1.69	48.91	-0.18	-0.21	1.64	56.01
2	470	Other Business Services	4.20	15.54	28.65	-0.06	-0.66	0.61	48.28
3	129	Pleating And Stitching	5.08	17.06	21.00	-0.06	-0.13	-0.28	42.67
4	57	Maintenance And Repair Oil And Gas Wells	3.30	21.95	14.05	-0.06	-0.22	2.65	41.66
5	96	Flavoring Extracts And Syrups, N.E.C.	9.29	1.97	27.85	-0.06	-0.30	0.42	39.17
6	424	Marking Devices	4.53	16.50	16.68	-0.06	-0.12	0.71	38.24
7	241	Pottery Products, N.E.C.	5.98	17.89	12.97	-0.06	-0.28	0.62	37.12
8	428	Brooms And Brushes	6.98	9.83	20.29	-0.60	-0.15	0.71	37.06
9	443	Electric Services	4.04	2.21	30.11	-0.24	-1.34	2.21	36.99
10	174	Newspapers	4.48	10.76	20.65	-0.19	-0.37	1.19	36.51
11	439	Arrangement Of Passenger Transport	2.57	16.79	15.98	-0.18	-0.63	1.92	36.43
12	469	Advertising	0.94	11.77	24.16	-0.06	-1.20	0.61	36.20
13	509	Research, Development & Testing	4.98	17.84	11.01	-1.10	-0.53	3.16	35.36
14	371	Phonograph Records And Tapes	2.52	8.90	23.61	-0.87	-0.06	1.21	35.31
15	181	Greeting Card Publishing	4.55	5.17	24.83	-0.19	-0.31	1.19	35.24
16	426	Costume Jewellery	4.89	11.71	18.29	-0.06	-0.37	0.71	35.17
17	54	New Government Facilities	6.89	7.79	16.77	-0.28	-0.19	2.58	33.56
18	135	Hardwood Dimension And Flooring	7.22	14.31	11.80	-0.03	-0.37	0.56	33.49
19	178	Miscellaneous Publishing	2.10	5.89	24.82	-0.19	-0.33	1.19	33.47
20	441	Communications, Except Radio And TV	0.71	4.76	26.48	-1.10	-0.33	2.51	33.05
21	511	State And Local Electric Utilities	6.58	2.89	32.21	-7.81	-3.09	2.21	33.00
22	79	Bread, Cake, And Related Products	4.14	5.99	22.41	-0.06	-0.60	0.42	32.31
23	138	Wood Kitchen Cabinets	6.06	11.31	14.37	-0.03	-0.27	0.56	31.99
24	55	Maintenance And Repair, Residential	3.98	9.78	15.64	-0.28	-0.33	2.58	31.38
25	475	Computer And Data Processing Services	2.24	9.71	19.85	-0.96	-0.44	0.61	31.01
26	176	Book Publishing	4.28	3.86	22.23	-0.19	-0.46	1.19	30.91
27	233	Brick And Structural Clay Tile	4.20	11.03	17.31	-0.06	-2.28	0.62	30.82
28	56	Maintenance And Repair Other Facilities	3.83	9.06	15.91	-0.46	-0.23	2.58	30.69
29	427	Fasteners, Buttons, Needles, Pins	4.82	12.30	13.02	-0.06	-0.18	0.71	30.60
30	367	Electric Lamps	5.60	5.96	20.31	-0.87	-1.65	1.21	30.56
31	113	Knit Underwear Mills	0.37	24.94	4.88	-0.06	-0.15	0.12	30.09
32	136	Special Product Sawmills, N.E.C.	4.56	14.53	10.30	-0.03	-0.07	0.56	29.85
33	440	Transportation Services	4.06	9.55	16.39	-0.95	-1.24	1.92	29.73
34	275	Cutlery	3.58	5.73	20.30	-0.14	-0.68	0.83	29.62
35	229	Leather Goods, N.E.C.	3.26	14.12	11.86	-0.06	-0.16	0.39	29.41
36	187	Industrial Gases	6.82	5.83	18.09	-1.29	-2.02	1.68	29.11
37	512	Other State And Local Govt Enterprises	4.11	5.80	25.96	-7.81	-2.28	3.29	29.08
38	154	Wood Office Furniture	4.54	10.59	13.51	-0.24	-0.22	0.90	29.07
39	412	Ophthalmic Goods	5.11	10.71	12.11	-0.06	-0.67	1.66	28.87
40	147	Wood Products, N.E.C.	4.78	12.78	12.25	-0.24	-1.31	0.56	28.82
41	280	Plumbing Fixture Fittings And Trims	5.08	6.82	16.56	-0.14	-0.64	0.83	28.51
42	183	Bookbinding & Related	2.49	16.12	8.63	-0.19	-0.35	1.19	27.88
43	418	Musical Instruments	2.69	11.56	13.51	-0.06	-0.63	0.71	27.78
44	250	Minerals, Ground Or Treated	7.57	6.30	15.11	-0.66	-1.48	0.62	27.46
45	435	Motor Freight Transport And Warehousing	5.21	9.59	14.04	-0.31	-1.19	0.09	27.44
46	152	Wood Tv And Radio Cabinets	5.60	13.21	7.94	-0.24	-0.12	0.90	27.28
47	270	Nonferrous Castings, N.E.C.	3.86	12.01	10.51	-0.14	-0.33	1.04	26.95
48	206	Explosives	5.14	7.59	12.80	-0.03	-0.67	1.68	26.51
49	142	Wood Pallets And Skids	4.78	13.23	7.86	-0.03	-0.13	0.56	26.27
50	131	Schiffi Machine Embroideries	10.55	10.77	5.51	-0.06	-0.35	-0.28	26.14
51	104	Cigarettes	0.63	0.87	23.09	0.00	-0.33	1.41	25.67
52	352	Fluid Power Pumps & Motors	3.06	13.24	8.22	-0.50	-0.04	1.66	25.64
53	402	Automatic Temperature Controls	2.06	12.07	11.21	-1.32	-0.22	1.66	25.45
54	298	Ammunition, Except For Small Arms	2.89	9.76	11.94	-0.14	-0.28	0.83	24.99
55	153	Household Furniture, N.E.C.	5.41	14.22	4.83	-0.24	-0.16	0.90	24.95
56	523	State & Local Government - Non-Educational	5.78	23.62	0.00	-7.81	0.00	3.29	24.89
57	304	Miscellaneous Fabricated Wire Products	4.13	9.18	11.77	-0.50	-0.63	0.83	24.77
58	184	Typesetting	2.19	12.15	9.72	-0.19	-0.29	1.19	24.77
59	148	Wood Household Furniture	5.36	10.74	8.21	-0.24	-0.39	0.90	24.58
60	157	Wood Partitions And Fixtures	5.59	10.12	8.43	-0.24	-0.27	0.90	24.53
61	320	Industrial Patterns	3.88	11.42	8.16	-0.50	-0.16	1.66	24.47
62	110	Womens Hosiery, Except Socks	5.88	11.99	6.74	0.00	-0.35	0.12	24.38
63	101	Manufactured Ice	2.54	13.88	15.76	-3.80	-4.45	0.42	24.36
64	376	Printed Circuit Boards	3.23	9.29	11.78	-0.87	-0.30	1.21	24.34



**Table 4-20: Adjusted Scores for Each Industry and Each Impact, Except Cleanliness of Industry, Halifax County (Continued)**

Rank Using Adjusted Score	IMPLAN Code	Sector Title	ADJUSTED SCORES						Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Impacts on Property Values	
65	128	Canvas Products	5.15	12.38	7.07	-0.06	-0.18	-0.28	24.07
66	243	Concrete Products, N.E.C.	3.24	9.70	11.13	-0.06	-0.87	0.62	23.76
67	419	Dolls	3.24	11.38	8.50	-0.06	-0.08	0.71	23.69
68	330	Food Products Machinery	4.83	7.06	11.12	-0.50	-0.55	1.66	23.62
69	339	Electronic Computers	4.63	4.76	13.36	-0.50	-0.36	1.66	23.55
70	321	Special Dies And Tools And Accessories	3.41	10.95	8.37	-0.50	-0.43	1.66	23.45
71	329	Printing Trades Machinery	3.44	7.23	11.82	-0.50	-0.19	1.66	23.44
72	160	Furniture And Fixtures, N.E.C.	6.02	4.96	11.79	-0.19	-0.21	0.90	23.26
73	368	Wiring Devices	3.70	7.63	11.87	-0.87	-0.55	1.21	22.98
74	303	Pipe, Valves, And Pipe Fittings	4.77	7.89	10.04	-0.14	-0.47	0.83	22.92
75	396	Complete Guided Missiles	3.93	4.63	13.09	-1.32	-0.23	1.66	21.76
76	447	Wholesale Trade	2.02	9.93	8.95	-0.06	-1.13	1.98	21.68
77	433	Railroads And Related Services	4.95	6.07	9.06	0.00	-0.59	1.92	21.41
78	515	Other Federal Government Enterprises	1.22	10.35	14.54	-7.81	-0.27	3.29	21.33
79	299	Small Arms	3.47	5.99	11.81	-0.14	-0.64	0.83	21.31
80	295	Plating And Polishing	2.43	11.27	9.30	-0.14	-2.42	0.83	21.26
81	369	Lighting Fixtures And Equipment	2.59	5.83	12.61	-0.87	-0.60	1.21	20.78
82	218	Gaskets, Packing And Sealing Devices	2.47	7.70	9.98	-0.04	-0.63	0.37	19.85
83	354	Industrial Machines N.E.C.	2.99	8.73	7.56	-0.87	-0.30	1.66	19.77
84	404	Instruments To Measure Electricity	2.81	6.36	10.34	-1.32	-0.26	1.66	19.59
85	269	Brass, Bronze, And Copper Foundries	2.67	8.47	9.04	-0.66	-1.00	1.04	19.55
86	109	Narrow Fabric Mills	0.84	12.16	6.60	0.00	-0.24	0.12	19.47
87	259	Iron And Steel Foundries	5.06	7.46	7.98	-0.66	-1.59	1.04	19.29
88	406	Optical Instruments & Lenses	1.96	7.65	9.10	-1.32	-0.23	1.66	18.81
89	359	Relays & Industrial Controls	2.01	6.11	10.29	-0.87	-0.85	1.21	17.90
90	215	Tires And Inner Tubes	3.27	5.16	9.69	-0.03	-0.59	0.37	17.87
91	284	Fabricated Plate Work	2.42	8.19	6.70	-0.14	-0.46	0.83	17.53
92	132	Fabricated Textile Products, N.E.C.	5.24	6.83	5.94	-0.03	-0.23	-0.28	17.46
93	377	Semiconductors And Related Devices	2.47	4.87	9.44	-0.87	-0.73	1.21	16.38
94	318	Machine Tools, Metal Cutting Types	2.54	8.06	4.85	-0.50	-0.54	1.66	16.06
95	319	Machine Tools, Metal Forming Types	3.34	8.12	3.66	-0.50	-0.75	1.66	15.53
96	185	Plate Making	2.23	7.73	5.53	-1.29	-0.37	1.19	15.01
97	381	Engine Electrical Equipment	3.77	6.63	5.51	-2.41	-0.87	1.21	13.83
98	520	Federal Government - Non-military	2.45	15.59	0.00	-7.81	0.00	3.29	13.53
99	94	Distilled Liquor, Except Brandy	3.84	1.48	8.19	-0.06	-0.46	0.42	13.41
100	513	U.S. Postal Service	7.55	13.65	-4.56	-7.81	-1.43	3.29	10.68

#### **Section 4.8: Summary of Results**

The differences between the sectors identified for targeting when using community preferences and a variety of economic and non-economic impacts compared to the top-ranked sectors from the initial ranking are substantial. For Bath County, only eight of the twenty highest-scoring sectors are in the top twenty for the initial ranking using the value-added effect. Montgomery County has similar statistics, with seven of the twenty highest-scoring sectors being in the top twenty initially ranked sectors. Only four of the highest-scoring sectors for Halifax County were in the top twenty initially ranked sectors. The other sectors recommended for targeting in this study may not have been identified if not for the inclusion of non-economic criteria and community preferences.

Several general conclusions can be drawn from observing the common AHP results of the case-study areas. The most notable shared priority for each county is cleanliness of industry. It is difficult to determine whether the participants' judgments for this impact reflect what realistically occurs in each county's development process, or if their judgments reflect the bias that is often found when the environment is being considered. The preference toward less polluting industries may be reflecting a locality's willingness to provide more incentives to a cleaner firm. The results do not necessarily reflect a county's willingness to reject industries that have higher levels of waste.

In general, the average wage offered by a firm was substantially more important to the participants than the number of jobs a firm would bring to the community. This

impact is something the literature had recommended be a consideration in the granting of incentives for several years (Shaffer, 1989). Despite the demonstrated importance of high average pay, in this research and other surveys (Bailey, 1996; Levy and Stephenson, 1994), states have done little to move its development focus away from high profile large employers that bring many new jobs to an area, but may not pay very well.

Next, contrary to the responses received by Bailey's survey of economic development agents (1996), the utility requirements of an industry was not an important consideration in any of the three case-study areas. Respondents in Bath County felt the county had enough capacity for utility requirements of most industries that might want to locate in the county. Montgomery and Halifax Counties' participants all felt that county sewer and water capacity could always be expanded to meet the needs of industries whose other impacts were more important.

The results demonstrate that community preferences can be systematically taken into consideration in the targeting process. Furthermore, including non-economic impacts do not necessarily make the industries identified for targeting less economically attractive. This research provides a method by which communities can take control of their economic future, without harming the quality of life in the area.

Community preferences for industry impacts indicate a changing atmosphere for economic development. In each of the three case-study areas, more service-oriented sectors were identified for targeting after community preferences were introduced to the targeting process. This indicates the need for economic development agencies (state and

local) to expand their focus to include non-manufacturing industries. Finally, this research provides specific steps communities can follow to direct their industrial targeting efforts in a manner consistent with community goals.

Identifying industries for targeting is only the first of many things that need to be done before an industry is likely to relocate to an area. A community must now learn what requirements these industries have of localities and try to meet those requirements. Local decisionmakers need to assess the strengths and weaknesses of their locality, so that they can take action to improve the community so as to have a greater chance in being successful in attracting a firm that has impacts that coincide with community preferences. The final step is to contact the firms of interest to the community. If that firm is considering expansion or relocation, a well-prepared community will have a greater chance in attracting that firm than an unprepared community.

## **Chapter 5: Conclusions**

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### **Section 5.1: Summary of Methods and Findings**

This research has provided communities with steps they can follow to identify industries for targeting. The methods incorporate a way for industries not already existing in a community to be considered for targeting. The Analytical Hierarchy Process gives local leaders a way to include their preferences for several of the economic, public, and environmental impacts a new or expanding firm might have on the area.

The results show that incorporating preferences has a substantial impact on the rank of industries. An industry that has potentially high economic impacts may in fact not be preferred by a community because of its non-economic impacts. In general, it was found that impacts such as the cleanliness of industry and average wage or salary, have a much greater effect on how preferred an industry is considered in a community than the number of jobs an industry would bring to the area. In addition to identify industries that would be recommended for targeting, these results have several policy implications (pursued in the next section).

The tools used in this research are easy to understand and implement. Community leaders having little experience should be able to follow the guidelines in this thesis, with little input from outside experts, to conduct his or her own industrial targeting research. Communities could use the results as a negotiation tool with industry, particularly in several citizen groups' preferences were also elicited. The results could also be used to help speed up the changes occurring at the state level. By emphasizing

community involvement by empowering local decisionmakers to conduct their own studies, this research is an example of what is meant by Third Wave economic development activities.

## **Section 5.2: Policy Implications**

Local leaders have their own idea of what is good for their community. This research shows that inclusion of local preferences results in different industries being identified for targeting than when not including these preferences. The diversity between each community's preferences and the articulation of these preferences during the process of making pairwise judgments highlight the need for states to include local leaders in the industry targeting process and also in other areas of economic development.

To illustrate, Bath County is concerned with raising the property tax base, while neither of the other two communities considered an industry's the impact on property values to be important. Bath County participants consider property values very important because the county has no sales and use tax, making property taxes the only local source of revenues for the county. Montgomery and Halifax counties, on the other hand, do not rely solely on property taxes for revenues, and therefore did not consider the impact a very important consideration in the industry identification process.

The priority rankings for the level of capital investment of a firm provide another example. This impact is very important in Halifax County, moderately important in Montgomery County, and relatively unimportant in Bath County, receiving weights of 23.1, 15.5, and 5.1 percent, respectively. Halifax and Montgomery counties felt the

possible tax revenues from higher levels of capital investment were an important consideration. Bath County, despite its desire and need of possible tax revenues (the importance of which is reflected by the weight calculated for the impacts on property values), decided in this case that it is more important for a firm to offer more jobs than increase capital investment.

Identifying industries that are attractive to residents is the first step in the industry recruitment process. Community leaders next need to assess what public resources are required or expected by each industry they have identified, and make an effort to provide those resources. Some of the resources decisionmakers may try to enhance are local infrastructure, local worker skill-levels, and local services, such as school, police and fire protection services. If a community is unable to finance the improvements that may be necessary to successfully attract the targeted firms, state money should be made available. Using state incentive money to finance improvements is particularly important if the area being considered has a higher than average unemployment rate. Studies show that incentive money spent in more depressed areas has higher social benefits than if that same money were spent in areas without high unemployment (Bartik 1995). “Benefits of employment growth are greater in high-unemployment areas because the unemployed there are more desperate for jobs” (Bartik, p.3, 1995). In any case, a firm is not likely to locate to an area that does not have a minimum level of public amenities, the requirements of which probably vary from firm to firm, no matter how desirable that firm

is to the community. The state may need to assist a community by providing information about or funding for enhancing certain local government services.

Some of the preference rankings common to each county also indicate areas where the state can make policy changes. In each case-study area, for example, creating well-paying jobs while keeping the environment as clean as possible were considered the two most important impacts contributing to the attractiveness of a firm. Programs should be structured so that incentives would be available for the types of firms that are environmentally friendly and offer higher wages. For example, an incentive policy might be set up that specifically targets firms with pollution levels below a prespecified limit. In order to provide more choices of industries to target, states may also choose to work with firms to make their level of waste more acceptable to the area in which the firm is thinking to locate, rather than have a community dismiss “dirty” firms out of hand. Creating an incentive that provides inducements to a firm to invest in pollution abatement technology and equipment is one way in which to “clean-up” a firm.<sup>1</sup> The state should work to find solutions that would help communities achieve their desire for cleaner industry.

Next, while communities want high paying jobs, if there are no skilled workers in the area, there is little chance of attracting a firm that offers high wages. To attract higher

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<sup>1</sup> The Clean Fuel Vehicle Tax Credit and the Clean Fuel Vehicle Job Creation Tax Credit are the only programs currently in Virginia that specifically address environmental considerations (Commonwealth of Virginia 1995).



quality jobs the workforce needs to obtain the skills needed to work in those jobs with higher pay. The answer is to educate the workforce. There is one program in Virginia aimed to meet the training needs of new or expanding firms.<sup>2</sup> The Workforce Services Training Program provides consulting and training video production services to firms spending at least \$500,000 in capital improvements. The budget for the Workforce Services Training Program is relatively small, \$3.2 million in 1994, compared to the funding levels of other incentive programs, such as the Governor's Opportunity Fund which had a 1994 budget of \$8.2 million. This is not to say that one incentive program should necessarily be decreased because worker training is more important. In fact, the Governor's Opportunity Fund is the most flexible financial incentive program in Virginia and has been successfully used to augment local effort during the final steps of negotiation between a locality and a firm.<sup>3</sup> Instead, the disparity in the levels of funding of the two programs depict the relative importance that has been placed on worker training. Rural communities want high paying jobs, but often lack the skilled workforce to fill those jobs. A greater emphasis on improving the skills of Virginia's workers is a forward step in making rural communities more competitive in the industrial recruitment process.

In summary, the differences between communities imply the need for maximum flexibility in development policies. The state should enable a community to identify what

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<sup>2</sup> The Federally funded Job Training Partnership Act Dislocated Worker Program also provides skill training to Virginia workers (Commonwealth of Virginia 1995).

<sup>3</sup> Most recently, the Governor's Opportunity Fund helped Lynchburg successfully attract a Frito Lay plant that will eventually employ over 800 workers.

needs to be accomplished before development can take place, rather than try to control the development process. Finally, incentive policies should be created with consideration for firm characteristics that are important to localities. Instead of focusing solely on the quantity of jobs a firm will create, states need to recognize there are other firm characteristics that affect the attractiveness of industry to a community. Future policies and incentive programs need to be formed with more than the number of jobs in mind.

### **Section 5.3: Further Research**

If a locality is going to subsidize industry, it needs to be able to predict how that industry will impact its economy, public services, and the quality of life of residents. To help identify the impacts that affect an industry's attractiveness to a community, this research included variables that seek to represent economic and non-economic impacts of the firm. Specifically, the number of jobs, the average wage or salary, and the level of capital investment of a firm measure the import of economic considerations. The levels of public service are represented by the impacts of population growth, utility requirements, and impact on property values. The population growth and property value impacts may also affect the quality of life in an area. The cleanliness of industry impact is also used as a measure of the changes in quality of life that may result from a firm relocation.

For some of these impacts data or models for measuring an impact were not available. This lack of available data forced the use of proxies in place of measurement of the actual impact, which was the weakest part of the model. Measuring the impact of

an industry location on property values, population growth, and the cleanliness of the environment are three areas of research that deserve more attention.

The impact of firm location or recruitment on property values created the most problems in this research. There were no known, easily accessible models that provide even a rough indication of the impact an industry would have on property values in a locality. This impact on property values was very important to Bath County because of the county's dependence on property tax revenues. This research uses a simple measure of the impact on property values, but the validity of the measure can be called into question. Better quantification of the impact of firm location on property values would be very beneficial to communities as the information could be used to better identify the types of industries that would help localities increase their property tax base.

Impacts of population growth were also measured using proxy information. The purpose of this criterion was to include some of the public or social costs from in-migration that may occur when a firm locates or expands in a community. A rough migration index was calculated for use with this research, but much work can still be done to better estimate these non-economic costs. The Virginia Impact Model (VIP) is a regression-based model that calculates population changes and the addition cost to taxpayers caused by these changes. This model would provide useful and perhaps a more accurate measurement of the impacts of population growth, but was not used because of time and data limitations.

A lot of research has been done in the past several years related to industry and the environment. The Toxic Release Report from the Environmental Protection Agency has only been conducted in 1995, measuring 1992 pollution levels. At the national level, more data should be collected to comprehensively include all toxic chemicals used in all industries, not just those engaged in manufacturing. Furthermore, data on the relative damage or risk (perhaps measured by the toxicity of chemicals used by industry ) caused by each firm should be made public. Additional research should attempt to value the effects of pollution in order for the cost to localities of accepting polluting firms to be calculated. Evaluating the costs of pollution is not a straightforward process, yet the implications for how communities determine the value of incentives offered to firms make it an important component in economic development.

Calculating the probability of a firm locating in a specific area is another way in which research could have a substantial effect on the industrial recruitment process. One of the biggest problems in development is that rural communities lack the resources and expertise to keep up with the changes occurring in the development profession. This makes these localities less competitive in the business of attracting firms. If a community knows what industries and industry impacts they want and they have an indication as to whether those particular industries are at all likely to locate in their area, the community could better justify the expense of recruiting efforts. Knowing the probability of a firm locating in an area would help the economic development agency focus their time and resources on those industries they are most likely to attract. The NEEDS model,

discussed in Chapter 3, is an example of a model that provides useful information about an industry's probability of locating in specific areas. An updated version of the NEEDS model, one that is more comprehensive and uses current data would be very useful to economic development agents.

#### **Section 5.4: Concluding Remarks**

Proactive industrial targeting can be a substantial part of the economic development program of rural areas. As budgets decline, the money spent to attract firms through marketing and incentives needs to be more carefully spent. This research has provided a way to easily implement preferences for different industry impacts into the targeting process.

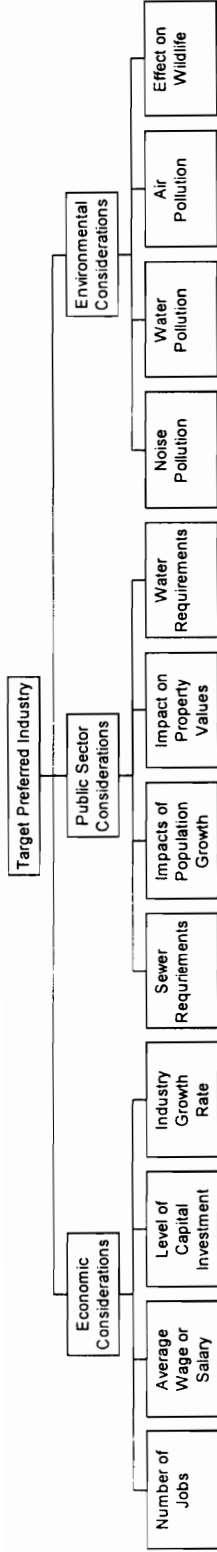
The Analytical Hierarchy Process proved conceptually easy to understand. The participants in the study were comfortable using subjective judgments to compare industry impacts. The inclusion of impacts that are generally not explicitly considered in economic development, much less industrial targeting, is another contribution of this research to economic development. A means was created during the study of adding data to the IMPLAN database in order for calculations to be performed on sectors not represented in a community. This addition represents an improvement over using several of the basic tools for industrial targeting, such as location quotients, because input-output includes the interlinkages between the sectors in the calculations.

The weights assigned to the criteria are ultimately of interest in this study as they are used to evaluate each industry. One extension of this research is that the weights of

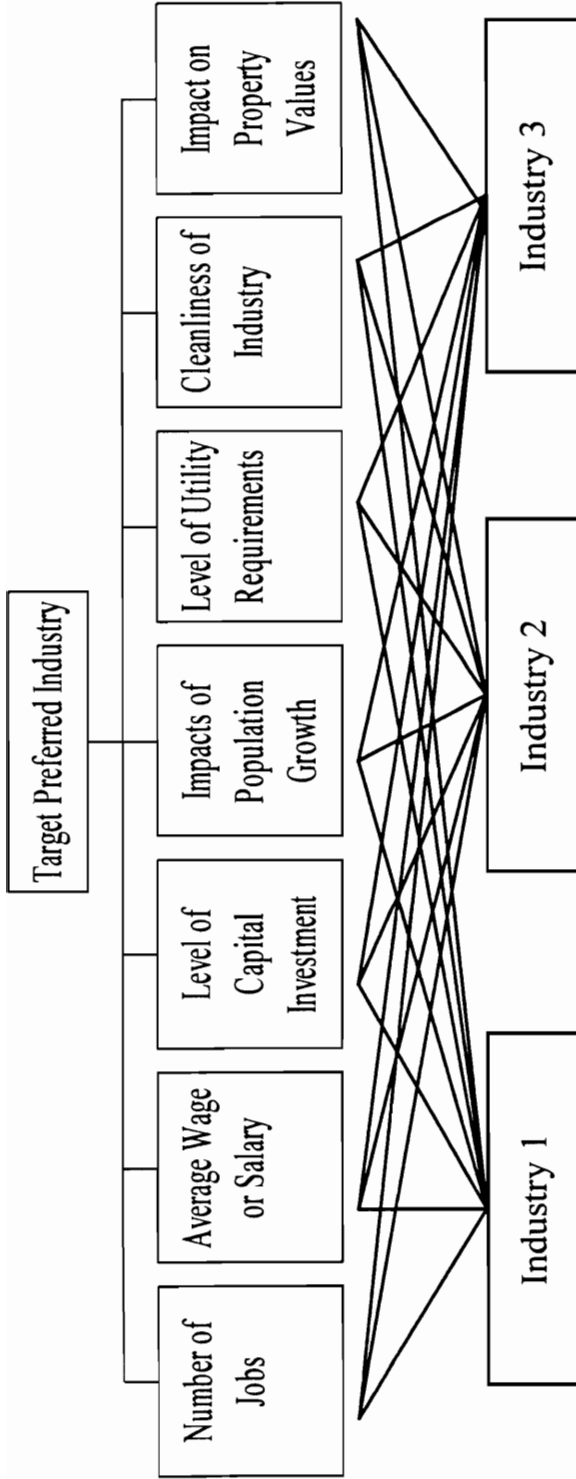
the criteria can be used as a screening device to evaluate industries, ex ante, that are currently interested in relocating to an area. Another extension would be to conduct the AHP over time in order to observe any changes in preferences occurring in a community.

Of course, there are improvements that could be made on the methods used in this research, many of which involve using more of the strengths of the AHP. First, the industrial targeting problem could be set up slightly differently in order for more firm impacts to be included in the study (Figure 5-1). Being able to include more impacts implies that the impact definitions could be narrowed and refined. This would perhaps make the measurement of several of the impacts more straightforward, although data limitation might still create problems.

Second, a more detailed hierarchy, one that includes industry alternatives (Figure 5-2), could be used if community leaders were willing to have substantially more involvement in the targeting process. If a researcher were to obtain a short list of industries and prepare a detailed report on each alternative industry that could be read and studied by participants, or if the participants independently educated himself or herself about each industry, then the AHP could be used by itself to rank each industry (See Saaty (1980) for a complete explanation). Community participants would have to spend time learning enough about each alternative industry to be able to qualify as an “expert” on that industry in order for his or her judgments to be meaningful.



**Figure 5-1: Hierarchy Expanded in Order to Include More Criteria**



**Figure 5-2: Hierarchy Expanded to Include Alternatives**



Finally, economic development is not an exact science. Rural areas face many constraints that differ between communities and depend on a variety of factors, such as distance to urban centers and access to higher education. The different constraints lead to communities with different development priorities. No matter what impacts are more important to a community, providing information so that a community can help themselves achieve their goals is the objective of this research. The industries recommended for targeting in this study are not the answer to rural problems. However, the more information community decisionmakers have about their area and the possibilities open to them, the better they can make the development process fit their goals.

## **Appendix A: IMPLAN Calculations**

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### **Section A.1: IMPLAN's Social Accounting Matrix**

IMPLAN combines several databases to make up the social accounts for a region (Table A-1). The Social Accounting Matrix (SAM) structure shows the flow of commodities to industry and vice-versa. Separate databases are used to represent the five main components in IMPLAN. The main components are employment, value added, output, final demands, and structural matrices (Lindall and Olson 1993). The data used in IMPLAN come from different sources, and in many cases are estimated. IMPLAN uses the SAM data to estimate the industry-industry accounts that are used in input-output analysis. For a more detailed description of the SAM used in IMPLAN refer to Lindall and Olson (1993) and USDA Forest Service (1994).

### **Section A.2: How IMPLAN Calculates the 'A' Matrix**

The two national data matrices, the National Byproducts Matrix and the National Absorption Matrix are the sources for all the regional model data. The National Byproducts Matrix is the proportion of each commodity produced by the different industries. The National Absorption Matrix is the proportion by which industries use inputs.

**Table A-1: Social Accounts used by IMPLAN**

	<b>Industry</b>	<b>Commodity</b>	<b>Factors</b>	<b>Institution</b>	<b>Exports</b>	<b>TOTAL</b>
<b>Industry</b>		<i>Make</i>				Total Industry Output
<b>Commodity</b>	<i>Use</i>			<i>Consumption</i>	<i>Exports</i>	Total Commodity Output
<b>Factors</b>	<i>Value Added</i>				<i>Exports</i>	Total Factor Income
<b>Institution</b>	<i>Sales and Taxes</i>	<i>Sales</i>			<i>Exports</i>	Total Institutional Income
<b>Imports</b>	<i>Imports</i>		<i>Imports</i>	<i>Imports</i>	<i>Transshipment</i>	Total Imports
<b>TOTAL</b>	Total Industry Outlay	Total Commodity Outlay	Total Factor Outlay	Total Institutional Expenditures	Total Exports	

Source: USDA Forest Service 1994

The National Byproducts Matrix is pre-multiplied by a diagonal matrix of Total Regional Industry Output, yielding the Regional Make Matrix. This matrix contains the proportion of each commodity produced in the region in question by industry (Equation A-1).

$$\begin{bmatrix} \text{Regional Make} \\ \text{Matrix} \end{bmatrix}_{I \times C} = \begin{bmatrix} \text{Total Regional} \\ \text{Industry Output} \end{bmatrix}_{I \times I}^{\wedge} * \begin{bmatrix} \text{National Byproducts} \\ \text{Matrix} \end{bmatrix}_{I \times C} \quad (\text{A-1})$$

It takes several steps to obtain the Net Commodity Use Matrix from the National Absorption Matrix. First, the National Absorption Matrix is multiplied by the diagonal matrix of the absorption adjustment ratios, producing the Regional Absorption Matrix (Equation A-2). The absorption adjustments ratios are the rate at which factor inputs (labor and capital) are substituted for intermediate inputs of industries in the region being modeled (USDA Forest Service 1994).

$$\begin{bmatrix} \text{Gross Regional} \\ \text{Absorption} \\ \text{Matrix} \end{bmatrix}_{C \times I} = \begin{bmatrix} \text{National Absorption} \\ \text{Matrix} \end{bmatrix}_{C \times I} * \begin{bmatrix} \text{Absorption Adjustment} \\ \text{Ratios} \end{bmatrix}_{I \times I}^{\wedge} \quad (\text{A-2})$$

The Gross Regional Absorption Matrix is then multiplied by the diagonal matrix of Total Regional Industry Output. This multiplication produces the Gross Commodity Use Matrix (Equation A-3). The previous two matrices are referred to as “Gross” because they still include imports into the region in question.

$$\begin{bmatrix} \text{Gross Commodity} \\ \text{Use Matrix} \end{bmatrix}_{\text{C} \times \text{I}} = \begin{bmatrix} \text{Regional Absorption} \\ \text{Matrix} \end{bmatrix}_{\text{C} \times \text{I}} * \begin{bmatrix} \hat{\text{Regional Total}} \\ \text{Output} \end{bmatrix}_{\text{I} \times \text{I}} \quad (\text{A-3})$$

To derive the intermediate demand for locally produced commodities, the dot product of the regional purchase coefficients for the region are applied to the Gross Regional Use Matrix, yielding the Net Commodity Use Matrix for the region under consideration (Equation A-4) (USDA Forest Service 1994).

$$\begin{bmatrix} \text{Net Commodity} \\ \text{Use Matrix} \end{bmatrix}_{\text{C} \times \text{I}} = \begin{bmatrix} \text{Gross Commodity} \\ \text{Use Matrix} \end{bmatrix}_{\text{C} \times \text{I}} * \begin{bmatrix} \dot{\text{Regional Purchase}} \\ \text{Coefficient} \end{bmatrix}_{\text{I} \times \text{I}} \quad (\text{A-4})$$

To summarize, the Regional Make Matrix contains the value of commodities *produced* by the different industries, while the Net Commodity Use Matrix is the amount of locally produced commodities *used* by each industry in the production process (United States Department of Agriculture Forest Service 1993). These constitute the I/O portion of the social accounting matrix used by IMPLAN.

IMPLAN derives two more data matrices, to be used in the final calculation of the transaction matrix. The Regional Market Share Matrix indicates the share of commodity production held by regional industrial producers, and is calculated by multiplying the Regional Make Matrix by the inverse of the diagonal matrix of Total Commodity Output (Equation A-5).

$$\begin{bmatrix} \text{Regional Market} \\ \text{Share Matrix} \end{bmatrix}_{\text{I} \times \text{C}} = \begin{bmatrix} \text{Regional Make} \\ \text{Matrix} \end{bmatrix}_{\text{I} \times \text{C}} * \begin{bmatrix} \hat{\text{Total Commodity}} \\ \text{Output} \end{bmatrix}_{\text{C} \times \text{C}}^{-1} \quad (\text{A-5})$$

The Regional Absorption By Industry Matrix is derived by multiplying the Net Commodity Use Matrix by the inverse of the diagonal matrix of Total Industry Outlay (Equation A-6). The Regional Absorption By Industry Matrix shows the proportion of each industry's commodity inputs that come from regional production (USDA Forest Service 1994).

$$\begin{bmatrix} \text{Regional Absorption} \\ \text{By Industry Matrix} \end{bmatrix}_{\text{C} \times \text{I}} = \begin{bmatrix} \text{Net Commodity} \\ \text{Use Matrix} \end{bmatrix}_{\text{C} \times \text{I}} * \begin{bmatrix} \hat{\text{Total Industry}} \\ \text{Outlay} \end{bmatrix}_{\text{I} \times \text{I}}^{-1} \quad (\text{A-6})$$

In order to obtain the standard industry-by-industry accounting system, the Market Share and the Regional Absorption by Industry Matrix are multiplied, the result being a matrix of technical coefficients, also known as the A matrix, and called the Regional Direct Coefficients Matrix in IMPLAN (Equation A-7). The A matrix consists of elements that represent the ratio of input to output within and between each industry in the matrix. For example, for purchases by industry 1 of industry 4's output, a direct coefficient of .02 means that for every dollar of industry 1's output, two cents worth of inputs are purchased from industry 4 (Miller and Blair 1985).

$$\begin{bmatrix} \text{Regional Direct} \\ \text{Coefficients Matrix} \end{bmatrix}_{\text{I} \times \text{I}} = \begin{bmatrix} \text{Regional Market} \\ \text{Share Matrix} \end{bmatrix}_{\text{I} \times \text{C}} * \begin{bmatrix} \text{Regional Absorption} \\ \text{By Industry Matrix} \end{bmatrix}_{\text{C} \times \text{I}} \quad (\text{A-7})$$

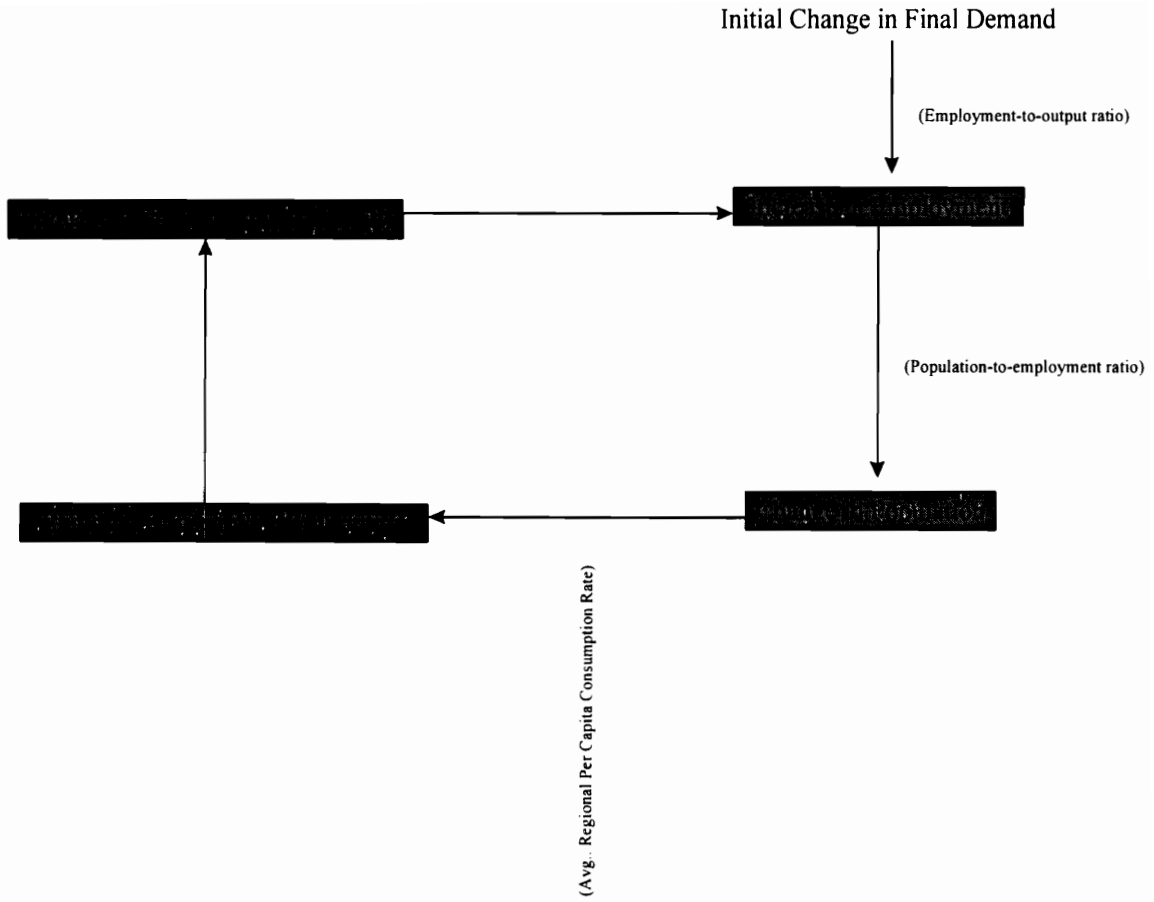
With the Regional Direct Coefficients Matrix calculated, IMPLAN calculations follow the standard form, with only one exception. IMPLAN, an open model, calculates the induced household effect differently than does a standard closed input-output model.

In the standard closed I/O model, the induced effects are calculated by assuming a linear relationship between income and consumption changes. This assumption means that a change in output will raise income, which in turn, will change consumption proportionately (Lindall and Olson 1993). Induced effects in IMPLAN are calculated iteratively, rather than recursively as with the standard closed model (Figure A-1).

IMPLAN assumes that as output increases, so does employment and population, which in turn affect final demand.<sup>1</sup> To estimate the induced effects, IMPLAN first calculates the indirect changes in employment using the employment-to-output ratio. The employment change is then used to predict the change in population using the population-to-employment ratio. The change in population is then multiplied by the average regional per capita consumption rates by sector to estimate the regional household consumption generated by the initial final demand changes. This is considered a change in final demand and is multiplied by the Leontief inverse to generate the first round of induced effects. The process is repeated iteratively until the population change is zero. When calculated in this manner, the developers of IMPLAN claim the induced effects tend to be less inflated than when calculated recursively in the standard manner (United States Department of Agriculture Forest Service 1993).

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<sup>1</sup> This next section is drawn heavily from Lindall and Olson, 1993.



**Figure A-1: IMPLAN's Calculation of Induced Effects**



## **Appendix B: Effect of Adding “Shadow” Industries**

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### **Section B.1: Introduction**

When conducting industrial targeting with an I/O model, it is usually necessary to add non-existing sectors to the I/O table in order to assure that sectors with potentially high impacts are not ignored. Industry data can be changed by editing the IMPLAN database. One way that data obtained by a researcher can be incorporated into IMPLAN is to change the regional study area data. The regional study area datafile is where demand, output, value-added and employment data for each sector are recorded. Adding even extremely small levels of output, value-added, and employment data for a sector to the study area datafile, in effect, causes the model to act as if that sector is present in the region under consideration. The added sectors are referred to as “shadow” sectors because the sectors are not actually located in the county and the potential linkages between these and other sectors are not fully measured.

The alternative method of estimating a non-existing sector’s impact is to conduct an impact analysis. This involves incrementally changing the final demand for existing sectors from which the hypothetical sector makes its purchases. The objective is to properly capture the backward linkages for the sector under consideration. Impact analysis was not done for this research primarily because historically available data for the expenditure patterns of hypothetical sectors was the national coefficients in IMPLAN. The purchases and purchase levels of more than 300 sectors, for each of the three counties, would have had to be collected and an impact analysis conducted. Due to

number of industries that need to be added to each county model and the amount of time each impact analyses would take, adding sectors by editing the study area data was the method chosen as a quick way to introduce missing sectors.

Using the “shadow” sector approach had several other advantages. The first advantage is that the impacts calculated for the “shadow” sectors are conservative. Backward linkages measure the increased demand of sector  $j$ , on the sectors whose products are used as inputs to production in sector  $j$ . Forward linkages, on the other hand, are defined as sector  $j$ 's production that is available to be used as inputs to other sectors for their own production. Forward linkages assume that the other sectors will increase their purchases of sector  $j$ 's output as sector  $j$  increases its production. This may not always be true, and can lead to an overestimation of the impact that sector  $j$  has on the local economy. By not including forward linkages, the impacts calculated for the “shadow” sectors are conservative and will not tend to inflate the regional impacts.

The second advantage is that the approach is accurate. By using Virginia production technology from IMPLAN itself, there is confidence in the consistency and rigor of the data, which is not always the case when using survey-based data. The third advantage is that this approach makes only marginal changes in the regional model. In order to determine the possible effects of adding sectors by adding data to the study area datafile, several tests needed to be performed. The results indicate that by adding very small sectors to the study area datafile, the impacts calculated for the rest of the sectors in the model change very little.

## Section B.2: Conceptual Issues

The Regional Purchase Coefficient (RPC) is the proportion of goods purchased locally that are used by local industries in the production process. The larger the RPC, the larger the local impacts. IMPLAN estimates the RPCs for each case-study area using statistical regressions calculated independently of the model and is limited by the supply/demand ratio (Equation B-1).

$$\text{Regional Purchase Coefficient} = \left( \frac{\text{Supply}}{\text{Demand}} \right) = \left( \frac{(X_j^r - E_j^r)}{(X_j^r - E_j^r + M_j^r)} \right) \quad (\text{B-1})$$

$X_j^r$  = Output of Sector  $j$ , Region R

$E_j^r$  = Exports of Sector  $j$ , Region R

$M_j^r$  = Imports of Sector  $j$  in Region R

## Section B.3: Test Set-up

The impact of the “shadow” sectors on the regional I/O multipliers was unknown. In order to estimate the impact experimentation with different size of “shadow” sectors was performed. Because the general effect of adding sectors is assumed to be similar for all counties, the tests were only conducted for one case-study area, Montgomery County.

Three sectors were chosen at random to be added to the Montgomery County base model. The sectors were Motorcycles, bicycles, and parts; Leather goods, N.E.C.; and Wood containers. Each sector was added independently of the other sectors. The data representing the “shadow” sectors were from the Virginia study area datafile. The final payment values (as discussed in Chapter 3, Section 3.6) were used to calculate the

employment, value-added, and output that would be added to the county model for each of the three test sectors.

Four test models were generated for each of the three test sectors. For the first test, the data were manipulated so that the final payment values represented the value-added and output of only one employee. The second, third, and fourth tests used final payment values that represent the value-added and output of ten, one hundred, and five hundred employees, respectively.

After each of the four tests for each sector were conducted, the reports containing the value-added information, called the multiplier reports in IMPLAN, were examined. The percentage change in total value-added from the base model, where there were no changes made, were calculated for each sector, for each of the four test models. The average percentage change for each test was also calculated. These results were used to determine what affect adding “shadow” sectors had on the other sectors’ value-added results.

#### **Section B.4: Results**

Adding a sector by editing the regional study area datafile, in general, deflated each sector’s value-added effect. Table B-1 shows the percentage change in the value-added effect for each sector when IMPLAN sector 395 (motorcycles, bicycles, and parts) is added to the model. Notice the impact on each sector’s value-added effect is small. In fact, the effect of adding one job or ten jobs for several sectors are the same, at least at four decimal places. The sector-by-sector changes in value-added were all very small for

the two other sectors that were added independently to the Montgomery County model, so their results are not displayed.

The average change of all sectors' value-added effect are also small (Table B-2). Adding the final payment values from one job to the Montgomery County study area datafile results in an average change in the value-added effect of under six-thousandths of a percentage point for each of the sectors used in the test. When the sectors added to the model are small, the average value-added effect does increase by a small amount in several instances, as seen with the Leather goods and Wood containers sectors. This occurs because there are several sectors very similar to the one that was added whose direct value-added effects actually increase, and thereby outweigh the deflationary effects caused by a decrease in each sector's RPC. Still, this only occurs when the changes are small. It is not until one hundred jobs and the corresponding final payment values are added to the model that the average percentage change in the total value-added effect is

**Table B-1: Sector-by-Sector Percentage Change in Value-Added from the Base Model, Montgomery County**

Code	Sector	Number of Jobs Added			
		One	Ten	One Hundred	Five Hundred
1	Dairy Farm Products	0.000000%	0.000000%	-0.144770%	-0.760043%
2	Poultry And Eggs	0.000000%	0.000000%	-0.312891%	-1.627034%
3	Ranch Fed Cattle	0.000000%	-0.028321%	-0.292646%	-1.444350%
4	Range Fed Cattle	0.000000%	-0.027105%	-0.280087%	-1.400434%
5	Cattle Feedlots	0.000000%	-0.014826%	-0.192735%	-0.934025%
6	Sheep, Lambs And Goats	0.000000%	-0.013996%	-0.209937%	-1.063681%
7	Hogs, Pigs And Swine	0.000000%	-0.027499%	-0.233741%	-1.127458%
8	Other Meat Animal Products	0.000000%	0.000000%	-0.135044%	-0.742741%
9	Miscellaneous Livestock	0.000000%	-0.015097%	-0.218901%	-1.102053%
11	Food Grains	0.000000%	-0.019240%	-0.173160%	-0.865801%
12	Feed Grains	0.000000%	-0.010116%	-0.101163%	-0.505817%
13	Hay And Pasture	0.000000%	-0.011818%	-0.118175%	-0.590877%
15	Tobacco	0.000000%	-0.025920%	-0.226801%	-1.108087%
16	Fruits	0.000000%	0.000000%	-0.069073%	-0.345363%
18	Vegetables	0.000000%	0.000000%	-0.045994%	-0.229970%
21	Oil Bearing Crops	0.000000%	-0.019032%	-0.203007%	-1.008691%
22	Forest Products	0.000000%	-0.012974%	-0.077841%	-0.363259%
23	Greenhouse And Nursery Products	0.000000%	0.000000%	-0.053586%	-0.294722%
24	Forestry Products	0.000000%	-0.018447%	-0.184487%	-1.033020%
25	Commercial Fishing	0.000000%	-0.007506%	-0.120102%	-0.645549%
26	Agricultural, Forestry, Fishery	0.000000%	-0.022502%	-0.213771%	-1.125113%
27	Landscape And Horticultural Services	0.000000%	-0.023855%	-0.222646%	-1.097328%
37	Coal Mining	0.000000%	-0.012729%	-0.076375%	-0.445519%
40	Dimension Stone	-0.011578%	-0.011579%	-0.104203%	-0.497858%
48	New Residential Structures	0.000000%	-0.013247%	-0.172208%	-0.834548%
49	New Industrial And Commercial Buildings	0.000000%	-0.013569%	-0.135685%	-0.664858%
50	New Utility Structures	0.000000%	-0.017957%	-0.143652%	-0.664392%
51	New Highways And Streets	0.000000%	-0.015122%	-0.136996%	-0.680478%
53	New Mineral Extraction Facilities	0.000000%	-0.012404%	-0.136443%	-0.669809%
54	New Government Facilities	0.000000%	-0.011608%	-0.104469%	-0.539525%
55	Maintenance And Repair, Residential	0.000000%	-0.011690%	-0.151976%	-0.748188%
56	Maintenance And Repair Other Facilities	0.000000%	-0.013408%	-0.134084%	-0.683299%
78	Prepared Feeds, N.E.C.	0.000000%	0.000000%	-0.174622%	-0.931315%
108	Broadwoven Fabric Mills And Finishing	0.000000%	0.000000%	-0.135318%	-0.695921%
124	Apparel Made From Purchased Materials	0.000000%	-0.029819%	-0.209236%	-1.569272%
133	Logging Camps And Logging Contractors	0.000000%	0.000000%	-0.119818%	-0.623053%
134	Sawmills And Planing Mills, General	0.000000%	-0.016426%	-0.131406%	-0.640604%
137	Millwork	0.000000%	-0.013428%	-0.161139%	-0.792265%
138	Wood Kitchen Cabinets	-0.012536%	-0.025072%	-0.175505%	-0.827379%
144	Prefabricated Wood Buildings	-0.015694%	-0.015694%	-0.172630%	-0.784683%
149	Upholstered Household Furniture	0.000000%	0.000000%	-0.131598%	-0.701857%
162	Paper Mills, Except Building Paper	0.000000%	0.000000%	-0.106195%	-0.530973%
163	Paperboard Mills	0.000000%	0.000000%	-0.095147%	-0.499524%
164	Paperboard Containers And Boxes	0.000000%	-0.020521%	-0.123127%	-0.554073%
165	Paper Coated & Laminated Packages	-0.027709%	-0.027710%	-0.249377%	-1.108340%
166	Paper Coated & Laminated N.E.C.	0.000000%	-0.022119%	-0.176952%	-0.906879%
167	Bags, Plastic	0.000000%	-0.030656%	-0.245248%	-1.134273%
168	Bags, Paper	-0.025654%	-0.025655%	-0.230888%	-1.051821%
171	Envelopes	0.000000%	-0.022553%	-0.248083%	-1.240415%
173	Converted Paper Products, N.E.C.	0.000000%	0.000000%	-0.165837%	-0.829187%
174	Newspapers	0.000000%	-0.010034%	-0.130444%	-0.642183%
175	Periodicals	-0.016620%	-0.016621%	-0.116337%	-0.565066%
176	Book Publishing	0.000000%	0.000000%	-0.099059%	-0.478785%
179	Commercial Printing	-0.017937%	-0.017938%	-0.161435%	-0.771300%
184	Typesetting	0.000000%	-0.010898%	-0.163470%	-0.806452%
206	Explosives	0.000000%	0.000000%	-0.087217%	-0.436083%
218	Gaskets, Packing And Sealing Devices	0.000000%	0.000000%	-0.102684%	-0.542761%
226	Luggage	0.000000%	0.000000%	-0.103275%	-0.575391%
230	Glass And Glass Products, Exc. Containers	-0.013827%	-0.013829%	-0.096792%	-0.483960%
244	Ready-mixed Concrete	0.000000%	-0.017464%	-0.139714%	-0.681104%
259	Iron And Steel Foundries	0.000000%	-0.014209%	-0.113669%	-0.554135%
285	Sheet Metal Work	0.000000%	0.000000%	-0.131752%	-0.677583%
294	Metal Stampings, N.E.C.	0.000000%	-0.020231%	-0.182076%	-0.890148%
321	Special Dies And Tools And Accessories	0.000000%	-0.020638%	-0.144464%	-0.722320%
354	Industrial Machines N.E.C.	0.000000%	-0.014734%	-0.132606%	-0.648298%
357	Motors And Generators	0.000000%	-0.016929%	-0.169291%	-1.320467%
360	Electrical Industrial Apparatus	0.000000%	-0.022815%	-0.136893%	-0.661647%
369	Lighting Fixtures And Equipment	0.000000%	-0.016892%	-0.101351%	-0.540541%
373	Radio And Tv Communication Equipment	0.000000%	0.000000%	-0.082156%	-0.410779%
378	Electronic Components, N.E.C.	0.000000%	0.000000%	-0.120385%	-0.581862%
386	Motor Vehicle Parts And Accessories	0.000000%	-0.021142%	-0.126850%	-0.676533%
395	Motorcycles, Bicycles, And Parts	0.000000%	0.000000%	0.000000%	0.000000%
407	Surgical And Medical Instruments	0.000000%	-0.015640%	-0.109478%	-0.500469%
433	Railroads And Related Services	0.000000%	-0.011697%	-0.095578%	-0.456194%
434	Local, Interurban Passenger Transit	0.000000%	-0.015564%	-0.147860%	-0.754864%
435	Motor Freight Transport And Warehousing	0.000000%	-0.012282%	-0.171948%	-0.847458%
436	Water Transportation	0.000000%	0.000000%	-0.046136%	-0.715110%
437	Air Transportation	0.000000%	-0.015293%	-0.076464%	-0.412907%
439	Arrangement Of Passenger Transportation	-0.009137%	-0.018275%	-0.127924%	-0.639620%
441	Communications, Except Radio And TV	0.000000%	0.000000%	-0.063891%	-0.319455%

**Table B-1: Sector-by-Sector Percentage Change in Value-Added from the Base Model, Montgomery County (Continued)**

Code	Sector	Number of Jobs Added			
		One	Ten	One Hundred	Five Hundred
442	Radio And Tv Broadcasting	0.000000%	-0.025770%	-0.244814%	-1.211184%
443	Electric Services	0.000000%	0.000000%	-0.039609%	-0.250858%
444	Gas Production And Distribution	0.000000%	0.000000%	-0.052812%	-0.237655%
445	Water Supply And Sewerage Systems	0.000000%	-0.023607%	-0.188857%	-0.967894%
446	Sanitary Services And Steam Supply	0.000000%	0.000000%	-0.105105%	-0.570571%
447	Wholesale Trade	0.000000%	-0.009414%	-0.103559%	-0.546037%
448	Building Materials & Gardening	0.000000%	-0.016420%	-0.123153%	-0.599343%
449	General Merchandise Stores	0.000000%	-0.014550%	-0.167321%	-0.836607%
450	Food Stores	-0.006898%	-0.020695%	-0.158664%	-0.793322%
451	Automotive Dealers & Service Stations	0.000000%	-0.008619%	-0.103430%	-0.525771%
452	Apparel & Accessory Stores	0.000000%	-0.016624%	-0.174549%	-0.897681%
453	Furniture & Home Furnishings Stores	0.000000%	-0.015837%	-0.134611%	-0.657218%
454	Eating & Drinking	0.000000%	-0.018245%	-0.200693%	-1.021711%
455	Miscellaneous Retail	-0.008454%	-0.016908%	-0.177530%	-0.887649%
456	Banking	0.000000%	0.000000%	-0.118985%	-0.581703%
457	Credit Agencies	0.000000%	-0.014986%	-0.254758%	-1.318747%
458	Security And Commodity Brokers	-0.001109%	-0.011091%	-0.099811%	-0.465787%
459	Insurance Carriers	0.000000%	-0.013841%	-0.110727%	-0.539792%
460	Insurance Agents And Brokers	0.000000%	-0.008709%	-0.113221%	-0.566103%
461	Owner-occupied Dwellings	0.000000%	0.000000%	-0.011808%	-0.059039%
462	Real Estate	0.000000%	0.000000%	-0.062572%	-0.302430%
463	Hotels And Lodging Places	0.000000%	-0.014706%	-0.161765%	-0.801471%
464	Laundry, Cleaning And Shoe Repair	0.000000%	-0.024498%	-0.214356%	-1.059530%
465	Portrait And Photographic Studios	0.000000%	-0.018678%	-0.196115%	-0.952559%
466	Beauty And Barber Shops	0.000000%	-0.019511%	-0.188606%	-0.949532%
467	Funeral Service And Crematories	0.000000%	-0.019712%	-0.137985%	-0.650503%
468	Miscellaneous Personal Services	-0.011682%	-0.023364%	-0.221963%	-1.098131%
469	Advertising	0.000000%	-0.014681%	-0.154151%	-0.792777%
470	Other Business Services	0.000000%	-0.017599%	-0.131996%	-0.668779%
471	Photofinishing, Commercial Photography	-0.010035%	-0.020070%	-0.170597%	-0.822809%
472	Services To Buildings	0.000000%	-0.024321%	-0.468170%	-1.319390%
473	Equipment Rental And Leasing	0.000000%	-0.008152%	-0.146755%	-0.741828%
474	Personnel Supply Services	0.000000%	-0.025930%	-0.274115%	-1.366869%
475	Computer And Data Processing Services	0.000000%	-0.010013%	-0.100130%	-0.480625%
476	Detective And Protective Services	0.000000%	-0.014378%	-0.136592%	-0.668584%
477	Automobile Rental And Leasing	0.000000%	-0.013367%	-0.160406%	-1.443657%
478	Automobile Parking And Car Wash	0.000000%	-0.020723%	-0.207225%	-1.022311%
479	Automobile Repair And Services	0.000000%	-0.014912%	-0.149120%	-0.730689%
480	Electrical Repair Service	-0.010104%	-0.020208%	-0.121249%	-0.969991%
481	Watch, Clock, Jewelry And Furniture Repair	0.000000%	-0.029653%	-0.256993%	-1.255313%
482	Miscellaneous Repair Shops	0.000000%	-0.008740%	-0.113626%	-0.638056%
483	Motion Pictures	0.000000%	-0.023627%	-0.212640%	-1.086828%
484	Theatrical Producers, Bands Etc	0.000000%	-0.009879%	-0.148192%	-0.800237%
485	Bowling Alleys And Pool Halls	0.000000%	-0.016215%	-0.162153%	-0.835090%
488	Amusement And Recreation Services	0.000000%	-0.017575%	-0.202109%	-0.992970%
489	Membership Sports And Recreation	0.000000%	-0.013604%	-0.170045%	-0.857026%
490	Doctors And Dentists	0.000000%	-0.009241%	-0.073930%	-0.369652%
491	Nursing And Protective Care	0.000000%	-0.014878%	-0.163654%	-0.803392%
492	Hospitals	0.000000%	-0.018513%	-0.129594%	-0.647968%
493	Other Medical And Health Services	0.000000%	-0.012384%	-0.136223%	-1.226006%
494	Legal Services	0.000000%	-0.009498%	-0.094985%	-0.465426%
495	Elementary And Secondary School	0.000000%	-0.027475%	-0.238117%	-1.163110%
496	Colleges, Universities, Schools	-0.009203%	-0.018406%	-0.184060%	-0.911099%
497	Other Educational Services	0.000000%	-0.014756%	-0.177069%	-0.944371%
498	Job Trainings & Related Services	0.000000%	-0.019775%	-0.217520%	-1.077714%
499	Child Day Care Services	-0.012525%	-0.025050%	-0.225451%	-1.077154%
500	Social Services, N.E.C.	0.000000%	-0.019990%	-0.179910%	-0.919540%
501	Residential Care	-0.007668%	-0.023003%	-0.237694%	-1.165465%
502	Other Nonprofit Organizations	-0.016437%	-0.032873%	-0.295858%	-1.413544%
503	Business Associations	0.000000%	-0.007670%	-0.107387%	-0.552274%
504	Labor And Civic Organizations	0.000000%	-0.021305%	-0.191748%	-0.944535%
505	Religious Organizations	0.000000%	-0.016898%	-0.202771%	-0.963163%
506	Engineering, Architectural Services	0.000000%	-0.010158%	-0.121902%	-0.619667%
507	Accounting, Auditing And Bookkeeping	0.000000%	-0.018567%	-0.148533%	-0.714816%
508	Management And Consulting Services	0.000000%	-0.011325%	-0.135909%	-0.668177%
509	Research, Development & Testing	0.000000%	-0.016936%	-0.127022%	-0.635109%
512	Other State And Local Govt Enterprises	0.000000%	0.000000%	-0.088183%	-0.428319%
513	U.S. Postal Service	0.000000%	-0.009722%	-0.097220%	-0.913864%
519	Federal Government - Military	0.000000%	-0.017960%	-0.167625%	-0.838123%
520	Federal Government - Non-military	0.000000%	-0.008753%	-0.052516%	-0.253829%
522	State & Local Government - Education	-0.006664%	-0.019993%	-0.146618%	-0.699767%
523	State & Local Government - Non-Education	0.000000%	-0.013829%	-0.131379%	-0.643065%
525	Household Industry-low Income	0.000000%	-0.024093%	-0.278791%	-1.387072%
528	Inventory Valuation Adjustment	0.000000%	0.000000%	0.000000%	0.000000%

**Table B-2: Percentage Change in the Value-added Effect from the Base Model, Montgomery County**

<b>Number of Jobs Added</b>	<b>Sector 395: Motorcycles, bicycles, and parts</b>	<b>Sector 229: Leather Goods, N.E.C.<sup>a</sup></b>	<b>Sector 141: Wood Containers</b>
<b>One</b>	-0.0017%	0.0057%	0.0045%
<b>Ten</b>	-0.0139%	0.0024%	-0.0031%
<b>One hundred</b>	-0.1527%	-0.1038%	-0.1359%
<b>Five hundred</b>	-0.7769%	-0.5543%	-0.9159%

a. Not Elsewhere Classified



more than one-tenth of one percent. Adding five hundred jobs and the corresponding final payment values result in a decrease of the average percentage change that is still less than one percent.

After some consideration it became clear the regional purchase coefficient (RPC) is what is largely causing the changes in the value-added effects of each industry. When a sector is added to a regional model, let's call it sector  $i^f$ , by editing the study area datafile, the level of production for the sector  $j^f$  does not increase. If sector  $j^f$ 's production does not increase, it follows that its exports also remain the same. However, sector  $i^f$  is purchasing its production inputs from somewhere. Looking back at Equation B-1, it is apparent that sector  $i^f$  increases the demand for the output of sector  $j$ . As the level of local demands increase, the RPC for sector  $j^f$  decreases. Furthermore, as more sectors are added to the regional case-study models, each existing sector's RPC becomes smaller. Lower RPCs have the effect of decreasing the impacts calculated by IMPLAN, including the value-added impacts.

### **Section B.5: Conclusion**

It seems clear that as more jobs or shadow sectors are added, the value-added effects deflate more. To keep the deflation to a minimum, the final payment values added to each case-study area's datafile need to be small. To keep the definition simple, final payment values representing one job for each sector was added to the case-study area models. Since there were approximately 300 sectors being added to each county model, the total deflationary effect is estimated to be between the levels caused by adding one

hundred jobs and five hundred jobs for one sector, which still represents a change substantially less than one percent.

## **Appendix C: Industry Scores Unadjusted by Community Preferences**

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The raw score each industry received for each impact are displayed in Table C-1, Table C-2, and Table C-3 for Bath, Montgomery, and Halifax County, respectively. These are the scores and rank of the industries if community preferences were not included in the targeting process.

**Table C-1: Raw Scores for Each Industry and Each Impact, Bath County**

Rank Using Raw Score	IMPLAN Code	Sector Title	RAW SCORES						Total Score	
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry		Impacts on Property Values
1	509	Research, Development & Testing	71.54	40.37	22.51	-12.80	-12.02	0.00	100.00	209.60
2	438	Pipe Lines, Except Natural Gas	6.77	85.83	100.00	-3.06	-4.64	0.00	7.93	192.84
3	57	Maintenance And Repair Oil And Gas Wells	88.00	31.99	28.73	-5.61	-5.05	0.00	27.02	165.08
4	54	New Government Facilities	31.25	53.78	34.28	-3.87	-4.23	0.00	49.32	160.52
5	441	Communications, Except Radio And TV	19.10	73.13	54.14	-11.56	-7.38	0.00	24.18	151.61
6	55	Maintenance And Repair, Residential	39.24	35.03	31.98	-3.87	-7.51	0.00	49.32	144.18
7	433	Railroads And Related Services	24.33	90.32	18.53	-7.71	-13.25	0.00	30.87	143.10
8	439	Arrangement Of Passenger Transportation	67.32	30.12	32.66	-2.27	-14.21	0.00	22.75	136.37
9	470	Other Business Services	62.32	24.68	58.57	-0.27	-14.89	0.00	4.64	135.05
10	113	Knit Underwear Mills	100.00	32.90	9.99	-1.73	-3.42	-8.76	1.65	130.62
11	352	Fluid Power Pumps & Motors	53.11	68.07	16.81	-4.91	-0.82	-10.57	8.80	130.49
12	129	Pleating And Stitching	68.43	26.78	42.94	-3.37	-3.01	-6.10	3.19	128.87
13	443	Electric Services	8.88	79.92	61.56	-12.90	-30.19	0.00	18.47	125.74
14	339	Electronic Computers	19.07	93.82	27.32	-4.91	-8.06	-10.57	8.80	125.48
15	475	Computer And Data Processing Services	38.94	49.89	40.58	-0.27	-9.84	0.00	4.64	123.94
16	424	Marking Devices	66.15	39.11	34.10	-0.19	-2.60	-15.55	0.68	121.71
17	371	Phonograph Records And Tape	35.69	73.28	48.27	-6.97	-1.37	-34.90	7.21	121.21
18	320	Industrial Patterns	45.81	65.42	16.68	-4.91	-3.55	-10.57	8.80	117.69
19	56	Maintenance And Repair Other Facilities	36.35	4.15	32.53	-3.87	-5.19	0.00	49.32	113.28
20	329	Printing Trades Machinery	28.97	68.51	24.16	-4.91	-4.37	-10.57	8.80	110.60
21	241	Pottery Products, N.E.C.	71.75	27.88	26.52	-0.19	-6.28	-10.51	1.23	110.39
22	440	Transportation Services	38.28	42.99	33.52	-2.27	-27.87	0.00	22.75	107.40
23	298	Ammunition, Except For Small Arms	39.13	65.84	24.41	-0.71	-6.28	-16.29	1.29	107.39
24	321	Special Dies And Tools And Accessories	43.90	59.98	17.10	-4.91	-9.56	-10.57	8.80	104.75
25	136	Special Product Sawmills, N.E.C.	58.26	28.81	21.06	-0.15	-1.50	-6.68	2.54	102.33
26	174	Newspapers	43.15	42.28	42.21	-1.42	-8.33	-19.19	3.43	102.13
27	79	Bread, Cake, And Related Products	24.04	49.85	45.82	-0.18	-13.52	-5.65	1.15	101.51
28	447	Wholesale Trade	39.81	53.31	18.29	-2.87	-25.41	0.00	17.84	100.98
29	427	Fasteners, Buttons, Needles, Pins	49.33	43.71	26.61	-0.19	-4.10	-15.55	0.68	100.51
30	402	Automatic Temperature Controls	48.39	55.58	22.91	-12.94	-5.05	-18.90	10.20	100.18
31	178	Miscellaneous Publishing	23.61	50.10	50.74	-1.42	-7.38	-19.19	3.43	99.90
32	419	Dolls	45.63	53.53	17.38	-0.19	-1.78	-15.55	0.68	99.72
33	135	Hardwood Dimension And Flooring	57.39	29.45	24.13	-0.15	-8.33	-6.68	2.54	98.35
34	428	Brooms And Brushes	39.41	35.22	41.47	-0.19	-3.28	-15.55	0.68	97.77
35	138	Wood Kitchen Cabinets	45.34	32.89	29.37	-0.15	-6.01	-6.68	2.54	97.30
36	275	Cutlery	22.99	63.32	41.49	-0.71	-15.30	-16.29	1.29	96.81
37	404	Instruments To Measure Electricity	25.48	75.60	21.15	-12.94	-5.87	-18.90	10.20	94.71
38	104	Cigarettes	3.48	100.00	47.21	-34.78	-7.38	-19.58	5.69	94.65
39	181	Greeting Card Publishing	20.72	47.09	50.76	-1.42	-6.97	-19.19	3.43	94.42
40	154	Wood Office Furniture	42.45	40.72	27.61	-2.03	-5.05	-17.02	7.50	94.18
41	229	Leather Goods, N.E.C.	56.62	30.04	24.24	-0.25	-3.55	-15.80	2.37	93.65
42	183	Bookbinding & Related	64.64	34.96	17.64	-1.42	-7.92	-19.19	3.43	92.13
43	94	Distilled Liquor, Except Brandy	5.92	84.29	16.75	-0.18	-10.38	-5.65	1.15	91.90
44	152	Wood Tv And Radio Cabinets	52.98	36.83	16.23	-2.03	-2.73	-17.02	7.50	91.75
45	426	Costume Jewelry	46.94	30.70	37.40	-0.19	-8.33	-15.55	0.68	91.65
46	330	Food Products Machinery	28.30	59.17	22.74	-4.91	-12.43	-10.57	8.80	91.09
47	184	Typesetting	48.71	45.73	19.88	-1.42	-6.42	-19.19	3.43	90.73
48	226	Luggage	36.69	35.70	33.14	-0.25	-2.32	-15.80	2.37	89.52
49	406	Optical Instruments & Lenses	30.66	66.84	18.60	-12.94	-5.19	-18.90	10.20	89.26
50	523	State & Local Government - Non-educational	94.74	46.73	0.00	-100.00	0.00	0.00	46.18	87.64
51	128	Canvas Products	49.63	33.76	14.44	-3.37	-4.10	-6.10	3.19	87.47
52	142	Wood Pallets And Skids	53.04	25.35	16.07	-0.15	-3.01	-6.68	2.54	87.16
53	153	Household Furniture, N.E.C.	57.01	34.43	9.88	-2.03	-3.69	-17.02	7.50	86.08
54	124	Apparel Made From Purchased Materials	47.58	28.01	20.02	-3.37	-3.55	-6.10	3.19	85.79
55	224	Shoes, Except Rubber	51.15	32.03	19.06	-0.25	-3.01	-15.80	2.37	85.54
56	318	Machine Tools, Metal Cutting Types	32.31	62.14	9.91	-4.91	-12.16	-10.57	8.80	85.53
57	157	Wood Partitions And Fixtures	40.58	44.66	17.24	-2.03	-6.15	-17.02	7.50	84.78
58	141	Wood Containers	50.83	27.82	12.89	-0.15	-2.87	-6.68	2.54	84.38
59	109	Narrow Fabric Mills	48.76	36.33	13.49	-1.73	-5.46	-8.76	1.65	84.27
60	396	Complete Guided Missiles	18.56	89.61	26.77	-23.59	-5.19	-33.50	10.20	82.85
61	185	Plate Making	30.98	65.77	11.30	-1.42	-8.33	-19.19	3.43	82.53
62	110	Womens Hosiery, Except Socks	48.10	36.09	13.78	-1.73	-7.79	-8.76	1.65	81.34
63	418	Musical Instruments	46.36	35.89	27.62	-0.19	-14.21	-15.55	0.68	80.61
64	469	Advertising	47.18	6.22	49.38	-0.27	-27.05	0.00	4.64	80.10
65	520	Federal Government - Non-military	62.53	70.79	0.00	-100.00	0.00	0.00	46.18	79.50
66	247	Cut Stone And Stone Products	47.98	36.33	15.99	-0.19	-11.34	-10.51	1.23	79.49
67	412	Ophthalmic Goods	42.96	48.40	24.76	-12.94	-15.03	-18.90	10.20	79.45
68	511	State And Local Electric Utilities	11.61	65.13	65.86	-12.90	-69.54	0.00	18.47	78.63
69	304	Miscellaneous Fabricated Wire Products	36.80	47.12	24.06	-0.71	-14.07	-16.29	1.29	78.21
70	319	Machine Tools, Metal Forming Types	32.57	61.01	7.48	-4.91	-16.80	-10.57	8.80	77.58
71	284	Fabricated Plate Work	32.83	56.92	13.70	-0.71	-10.25	-16.29	1.29	77.50
72	137	Millwork	36.50	37.34	23.63	-0.15	-18.85	-6.68	2.54	74.33
73	160	Furniture And Fixtures, N.E.C.	19.89	46.10	24.10	-2.03	-4.64	-17.02	7.50	73.90

**Table C-1: Raw Scores for Each Industry and Each Impact, Bath County  
(Continued)**

Rank Using Raw Score	IMPLAN Code	Sector Title	RAW SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
74	147	Wood Products, N.E.C.	51.25	29.11	25.03	-0.15	-29.51	-6.68	2.54	71.59
75	299	Small Arms	24.04	53.31	24.14	-0.71	-14.48	-16.29	1.29	71.30
76	148	Wood Household Furniture	43.06	31.69	16.78	-2.03	-8.74	-17.02	7.50	71.23
77	421	Sporting And Athletic Goods, N.E.C.	30.76	35.18	32.62	-0.19	-12.70	-15.55	0.68	70.80
78	376	Printed Circuit Boards	37.27	47.76	24.09	-6.97	-6.69	-34.90	7.21	67.76
79	377	Semiconductors And Related Devices	19.52	79.34	19.29	-6.97	-16.39	-34.90	7.21	67.11
80	132	Fabricated Textile Products, N.E.C.	27.38	33.42	12.15	-3.37	-5.19	-6.10	3.19	61.48
81	368	Wiring Devices	30.60	52.92	24.26	-6.97	-12.43	-34.90	7.21	60.69
82	375	Electron Tubes	25.38	67.75	15.93	-6.97	-14.48	-34.90	7.21	59.91
83	206	Explosives	30.43	62.46	26.17	-12.86	-15.03	-46.03	13.14	58.29
84	233	Brick And Structural Clay Tile	44.22	36.14	35.40	-0.19	-51.23	-10.51	1.23	55.06
85	367	Electric Lamps	23.88	61.22	41.52	-6.97	-37.02	-34.90	7.21	54.94
86	187	Industrial Gases	23.39	84.06	36.98	-12.86	-45.36	-46.03	13.14	53.32
87	359	Relays & Industrial Controls	24.52	60.48	21.04	-6.97	-19.13	-34.90	7.21	52.25
88	222	Footwear Cut Stock	44.87	32.36	16.05	-0.25	-31.42	-15.80	2.37	48.17
89	515	Other Federal Government Enterprises	41.50	35.92	29.73	-100.00	-6.15	0.00	46.18	47.18
90	295	Plating And Polishing	45.21	45.63	19.00	-0.71	-54.37	-16.29	1.29	39.76
91	381	Engine Electrical Equipment	26.59	55.75	11.26	-6.97	-19.54	-34.90	7.21	39.40
92	191	Plastics Materials And Resins	7.92	80.62	23.43	-12.86	-32.79	-46.03	13.14	33.43
93	58	Meat Packing Plants	8.24	39.90	-6.32	-0.18	-6.97	-5.65	1.15	30.18
94	513	U.S. Postal Service	54.72	69.82	-9.33	-100.00	-32.24	0.00	46.18	29.16
95	270	Nonferrous Castings, N.E.C.	48.17	56.88	21.49	-5.17	-7.38	-100.00	4.32	18.32
96	512	Other State And Local Govt Enterprises	23.25	46.98	53.08	-100.00	-51.23	0.00	46.18	18.27
97	101	Manufactured Ice	55.67	33.39	32.23	-0.18	-100.00	-5.65	1.15	16.61
98	271	Metal Heat Treating	22.89	57.88	34.44	-5.17	-32.38	-100.00	4.32	-18.01
99	269	Brass, Bronze, And Copper Foundries	33.95	52.38	18.49	-5.17	-22.40	-100.00	4.32	-18.43
100	259	Iron And Steel Foundries	29.94	59.85	16.31	-5.17	-35.66	-100.00	4.32	-30.40

**Table C-2: Raw Scores for Each Industry and Each Impact, Montgomery County**

Rank	IMPLAN Code	Sector Title	RAW SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
1	509	Research, Development & Testing	71.54	43.03	22.51	-12.19	-12.02	0.00	81.92	206.82
2	438	Pipe Lines, Except Natural Gas	6.77	91.48	100.00	-0.72	-4.64	0.00	6.02	185.18
3	441	Communications, Except Radio And TV	19.10	77.95	54.14	-7.18	-7.38	0.00	19.94	181.51
4	54	New Government Facilities	31.25	57.32	34.28	-5.78	-4.23	0.00	100.00	167.89
5	55	Maintenance And Repair, Residential	39.24	37.33	31.98	-5.78	-7.51	0.00	100.00	150.32
6	49	New Industrial And Commercial Buildings	36.30	42.50	26.98	-5.78	-5.60	0.00	100.00	149.46
7	523	State & Local Government - Non-Education	94.74	49.80	0.00	-73.43	0.00	0.00	26.58	144.54
8	443	Electric Services	8.88	85.18	61.56	-7.60	-30.19	0.00	20.95	140.67
9	520	Federal Government - Non-military	62.53	75.45	0.00	-73.43	0.00	0.00	26.58	137.98
10	433	Railroads And Related Services	24.33	96.26	18.53	-9.82	-13.25	0.00	78.88	127.60
11	439	Arrangement Of Passenger Transp	67.32	32.10	32.66	-2.46	-14.21	0.00	54.85	127.11
12	442	Radio And Tv Broadcasting	24.96	63.27	17.35	-7.18	-19.26	0.00	19.94	124.02
13	352	Fluid Power Pumps & Motors	53.11	72.55	16.81	-0.59	-0.82	-10.57	2.96	123.46
14	339	Electronic Computers	19.07	100.00	27.32	-0.59	-8.06	-10.57	2.96	120.15
15	56	Maintenance And Repair Other Facilities	36.35	4.42	32.53	-5.78	-5.19	0.00	100.00	117.38
16	48	New Residential Structures	37.76	3.45	28.48	-5.78	-6.97	0.00	100.00	112.00
17	320	Industrial Patterns	45.81	69.73	16.68	-0.59	-3.55	-10.57	2.96	110.48
18	23	Greenhouse And Nursery Products	65.27	15.23	90.19	-1.62	-5.19	0.00	27.11	110.44
19	329	Printing Trades Machinery	28.97	73.02	24.16	-0.59	-4.37	-10.57	2.96	103.59
20	515	Other Federal Government Enterprises	41.50	38.28	29.73	-73.43	-6.15	0.00	26.58	103.36
21	447	Wholesale Trade	39.81	56.82	18.29	-2.37	-25.41	0.00	35.16	101.86
22	440	Transportation Services	38.28	45.82	33.52	-2.46	-27.87	0.00	54.85	98.99
23	321	Special Dies And Tools And Accessories	43.90	63.93	17.10	-0.59	-9.56	-10.57	2.96	97.18
24	402	Automatic Temperature Controls	48.39	59.23	22.91	-0.61	-5.05	-18.90	0.86	96.71
25	511	State And Local Electric Utilities	11.61	69.42	65.86	-7.60	-69.54	0.00	20.95	92.58
26	404	Instruments To Measure Electricity	25.48	80.58	21.15	-0.61	-5.87	-18.90	0.86	92.56
27	513	U.S. Postal Service	54.72	74.42	-9.33	-73.43	-32.24	0.00	26.58	87.57
28	396	Complete Guided Missiles	18.56	95.50	26.77	-1.11	-5.19	-33.50	0.86	87.15
29	406	Optical Instruments & Lenses	30.66	71.24	18.60	-0.61	-5.19	-18.90	0.86	86.53
30	330	Food Products Machinery	28.30	63.06	22.74	-0.59	-12.43	-10.57	2.96	83.47
31	318	Machine Tools, Metal Cutting Types	32.31	66.23	9.91	-0.59	-12.16	-10.57	2.96	78.11
32	412	Ophthalmic Goods	42.96	51.59	24.76	-0.61	-15.03	-18.90	0.86	75.50
33	512	Other State And Local Govt Enterprises	23.25	50.08	53.08	-73.43	-51.23	0.00	26.58	75.18
34	459	Insurance Carriers	21.20	65.66	-4.48	-0.62	-20.63	0.00	1.71	74.76
35	319	Machine Tools, Metal Forming Types	32.57	65.02	7.48	-0.59	-16.80	-10.57	2.96	70.08
36	371	Phonograph Records And Tape	35.69	78.10	48.27	-8.07	-1.37	-34.90	3.56	69.58
37	174	Newspapers	43.15	45.07	42.21	-2.70	-8.33	-19.19	7.39	62.24
38	178	Miscellaneous Publishing	23.61	53.40	50.74	-2.70	-7.38	-19.19	7.39	60.51
39	206	Explosives	30.43	66.58	26.17	-0.19	-15.03	-46.03	0.16	56.27
40	181	Greeting Card Publishing	20.72	50.19	50.76	-2.70	-6.97	-19.19	7.39	54.84
41	187	Industrial Gases	23.39	89.59	36.98	-0.19	-45.36	-46.03	0.16	52.73
42	183	Bookbinding & Related	64.64	37.26	17.64	-2.70	-7.92	-19.19	7.39	51.75
43	184	Typesetting	48.71	48.74	19.88	-2.70	-6.42	-19.19	7.39	51.06
44	470	Other Business Services	62.32	26.30	58.57	-7.95	-14.89	0.00	14.84	50.61
45	424	Marking Devices	66.15	41.69	34.10	-8.33	-2.60	-15.55	25.76	47.91
46	185	Plate Making	30.98	70.10	11.30	-2.70	-8.33	-19.19	7.39	44.18
47	475	Computer And Data Processing Se	38.94	53.18	40.58	-7.95	-9.84	0.00	14.84	41.16
48	182	Blankbooks And Looseleaf Binder	21.12	53.04	27.15	-2.70	-5.05	-19.19	7.39	36.40
49	298	Ammunition, Except For Small Arms	39.13	70.17	24.41	-11.73	-6.28	-16.29	24.54	36.39
50	427	Fasteners, Buttons, Needles, Pins	49.33	46.59	26.61	-8.33	-4.10	-15.55	25.76	27.01
51	419	Dolls	45.63	57.06	17.38	-8.33	-1.78	-15.55	25.76	26.87
52	275	Cutlery	22.99	67.49	41.49	-11.73	-15.30	-16.29	24.54	25.64
53	241	Pottery Products, N.E.C.	71.75	29.72	26.52	-13.02	-6.28	-10.51	32.72	24.92
54	428	Brooms And Brushes	39.41	37.54	41.47	-8.33	-3.28	-15.55	25.76	23.72
55	154	Wood Office Furniture	42.45	43.40	27.61	-12.43	-5.05	-17.02	48.69	18.71
56	426	Costume Jewellery	46.94	32.72	37.40	-8.33	-15.55	-15.55	25.76	17.30
57	136	Special Product Sawmills, N.E.C.	58.26	30.70	21.06	-9.13	-1.50	-6.68	41.15	17.07
58	152	Wood Tv And Radio Cabinets	52.98	39.25	16.23	-12.43	-2.73	-17.02	48.69	16.03
59	140	Structural Wood Members, N.E.C.	45.34	35.06	29.37	-9.13	-3.69	-6.68	41.15	14.62
60	376	Printed Circuit Boards	37.27	50.90	24.09	-8.07	-6.69	-34.90	3.56	14.45
61	135	Hardwood Dimension And Flooring	57.39	31.39	24.13	-9.13	-8.33	-6.68	41.15	13.13
62	138	Wood Kitchen Cabinets	45.34	35.06	29.37	-9.13	-6.01	-6.68	41.15	12.30
63	153	Household Furniture, N.E.C.	57.01	36.70	9.88	-12.43	-3.69	-17.02	48.69	10.20
64	157	Wood Partitions And Fixtures	40.58	47.60	17.24	-12.43	-6.15	-17.02	48.69	9.58
65	368	Wiring Devices	30.60	56.40	24.26	-8.07	-12.43	-34.90	3.56	7.72
66	418	Musical Instruments	46.36	38.25	27.62	-8.33	-14.21	-15.55	25.76	6.60
67	304	Miscellaneous Fabricated Wire Products	36.80	50.22	24.06	-11.73	-14.07	-16.29	24.54	5.98
68	284	Fabricated Plate Work	32.83	60.66	13.70	-11.73	-10.25	-16.29	24.54	5.92
69	303	Pipe, Valves, And Pipe Fittings	31.65	55.16	20.52	-11.73	-10.52	-16.29	24.54	5.77
70	367	Electric Lamps	23.88	65.24	41.52	-8.07	-37.02	-34.90	3.56	2.52
71	142	Wood Pallets And Skids	53.04	27.02	16.07	-9.13	-3.01	-6.68	41.15	1.67
72	359	Relays & Industrial Controls	24.52	64.46	21.04	-8.07	-19.13	-34.90	3.56	-0.22

**Table C-2: Raw Scores for Each Industry and Each Impact, Montgomery County  
(Continued)**

Rank Using Raw Score	IMPLAN Code	Sector Title	RAW SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
73	299	Small Arms	24.04	56.82	24.14	-11.73	-14.48	-16.29	24.54	-0.52
74	141	Wood Containers	50.83	29.65	12.89	-9.13	-2.87	-6.68	41.15	-0.95
75	160	Furniture And Fixtures, N.E.C.	19.89	49.13	24.10	-12.43	-4.64	-17.02	48.69	-1.21
76	148	Wood Household Furniture	43.06	33.77	16.78	-12.43	-8.74	-17.02	48.69	-4.83
77	247	Cut Stone And Stone Products	47.98	38.72	15.99	-13.02	-11.34	-10.51	32.72	-5.42
78	469	Advertising	47.18	6.63	49.38	-7.95	-27.05	0.00	14.84	-5.56
79	137	Millwork	36.50	39.80	23.63	-9.13	-18.85	-6.68	41.15	-10.37
80	243	Concrete Products, N.E.C.	38.91	42.22	22.75	-13.02	-19.54	-10.51	32.72	-12.43
81	147	Wood Products, N.E.C.	51.25	31.02	25.03	-9.13	-29.51	-6.68	41.15	-13.65
82	253	Nonmetallic Mineral Products, N.E.C.	36.62	39.69	29.58	-13.02	-23.77	-10.51	32.72	-14.66
83	230	Glass And Glass Products, Exc Containers	30.68	50.73	26.45	-13.02	-29.37	-10.51	32.72	-18.28
84	229	Leather Goods, N.E.C.	56.62	32.01	24.24	-32.03	-3.55	-15.80	45.44	-24.61
85	79	Bread, Cake, And Related Products	24.04	53.13	45.82	-44.86	-13.52	-5.65	38.53	-26.47
86	233	Brck And Structural Clay Tile	44.22	38.52	35.40	-13.02	-51.23	-10.51	32.72	-29.87
87	295	Plating And Polishing	45.21	48.63	19.00	-11.73	-54.37	-16.29	24.54	-32.57
88	94	Distilled Liquor, Except Brandy	5.92	89.84	16.75	-44.86	-10.38	-5.65	38.53	-33.80
89	223	House Slippers	39.77	32.77	30.06	-32.03	-3.01	-15.80	45.44	-34.33
90	129	Pleating And Stitching	68.43	28.55	42.94	-66.82	-3.01	-6.10	56.95	-44.84
91	113	Knit Underwear Mills	100.00	35.07	9.99	-100.00	-3.42	-8.76	47.65	-57.98
92	222	Footwear Cut Stock	44.87	34.49	16.05	-32.03	-31.42	-15.80	45.44	-69.93
93	435	Motor Freight Transport And Warehousing	38.47	4.27	28.71	-14.07	-26.64	0.00	44.97	-71.44
94	128	Canvas Products	49.63	35.99	14.44	-66.82	-4.10	-6.10	56.95	-85.78
95	271	Metal Heat Treating	22.89	61.69	34.44	-22.82	-32.38	-100.00	30.96	-99.64
96	109	Narrow Fabric Mills	48.76	38.72	13.49	-100.00	-5.46	-8.76	47.65	-104.10
97	110	Womens Hosiery, Except Socks	48.10	38.47	13.78	-100.00	-7.79	-8.76	47.65	-107.05
98	132	Fabricated Textile Products, N.E.C.	27.38	35.62	12.15	-66.82	-5.19	-6.10	56.95	-111.79
99	259	Iron And Steel Foundries	29.94	63.79	16.31	-22.82	-35.66	-100.00	30.96	-111.90
100	101	Manufactured Ice	55.67	35.59	32.23	-44.86	-100.00	-5.65	38.53	-112.44

**Table C-3: Raw Scores for Each Industry and Each Impact, Halifax County**

Rank Using Raw Score	IMPLAN Code	Sector Title	RAW SCORES							Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values	
1	54	New Government Facilities	65.27	31.25	34.28	-3.57	-4.23	0.00	78.29	123.00
2	55	Maintenance And Repair, Residential	37.76	39.24	31.98	-3.57	-7.51	0.00	78.29	97.89
3	56	Maintenance And Repair Other Facilities	36.30	36.35	32.53	-5.86	-5.19	0.00	78.29	94.13
4	57	Maintenance And Repair Oil And Gas Wells	31.25	88.00	28.73	-0.77	-5.05	0.00	80.49	142.16
5	79	Bread, Cake, And Related Products	39.24	24.04	45.82	-0.77	-13.52	-5.65	12.85	89.15
6	94	Distilled Liquor, Except Brandy	36.35	5.92	16.75	-0.77	-10.38	-5.65	12.85	42.22
7	96	Flavoring Extracts And Syrups, N.E.C.	88.00	7.92	56.94	-0.77	-6.83	-5.65	12.85	139.61
8	101	Manufactured Ice	24.04	55.67	32.23	-48.67	-100.00	-5.65	12.85	-42.38
9	104	Cigarettes	5.92	3.48	47.21	-0.03	-7.38	-19.58	42.95	29.63
10	109	Narrow Fabric Mills	7.92	48.76	13.49	-0.03	-5.46	-8.76	3.50	55.92
11	110	Womens Hosiery, Except Socks	55.67	48.10	13.78	-0.03	-7.79	-8.76	3.50	100.97
12	113	Knit Underwear Mills	3.48	100.00	9.99	-0.77	-3.42	-8.76	3.50	100.52
13	128	Canvas Products	48.76	49.63	14.44	-0.77	-4.10	-6.10	-8.49	101.88
14	129	Pleating And Stitching	48.10	68.43	42.94	-0.77	-3.01	-6.10	-8.49	149.59
15	131	Schuffi Machine Embroideries	100.00	43.18	11.26	-0.77	-7.92	-6.10	-8.49	139.65
16	132	Fabricated Textile Products, N.E.C.	49.63	27.38	12.15	-0.44	-5.19	-6.10	-8.49	77.43
17	135	Hardwood Dimension And Flooring	68.43	57.39	24.13	-0.44	-8.33	-6.68	17.11	134.50
18	136	Special Product Sawmills, N.E.C.	43.18	58.26	21.06	-0.44	-1.50	-6.68	17.11	113.88
19	138	Wood Kitchen Cabinets	57.39	45.34	29.37	-0.44	-6.01	-6.68	17.11	118.97
20	142	Wood Pallets And Skids	45.34	53.04	16.07	-0.44	-3.01	-6.68	17.11	104.32
21	147	Wood Products, N.E.C.	45.34	51.25	25.03	-3.09	-29.51	-6.68	17.11	82.34
22	148	Wood Household Furniture	50.83	43.06	16.78	-3.09	-8.74	-17.02	27.29	81.81
23	152	Wood Tv And Radio Cabinets	53.04	52.98	16.23	-3.09	-2.73	-17.02	27.29	99.40
24	153	Household Furniture, N.E.C.	51.25	57.01	9.88	-3.09	-3.69	-17.02	27.29	94.34
25	154	Wood Office Furniture	43.06	42.45	27.61	-3.09	-5.05	-17.02	27.29	87.95
26	157	Wood Partitions And Fixtures	52.98	40.58	17.24	-3.09	-6.15	-17.02	27.29	84.53
27	160	Furniture And Fixtures, N.E.C.	57.01	19.89	24.10	-2.45	-4.64	-17.02	27.29	76.88
28	174	Newspapers	42.45	43.15	42.21	-2.45	-8.33	-19.19	36.04	97.85
29	176	Book Publishing	40.58	15.47	45.45	-2.45	-10.38	-19.19	36.04	69.49
30	178	Miscellaneous Publishing	19.89	23.61	50.74	-2.45	-7.38	-19.19	36.04	65.23
31	181	Greeting Card Publishing	43.15	20.72	50.76	-2.45	-6.97	-19.19	36.04	86.03
32	183	Bookbinding & Related Services	23.61	64.64	17.64	-2.45	-7.92	-19.19	36.04	76.33
33	184	Typesetting	20.72	48.71	19.88	-2.45	-6.42	-19.19	36.04	61.25
34	185	Plate Making	21.12	30.98	11.30	-16.51	-8.33	-19.19	36.04	19.36
35	187	Industrial Gases	64.64	23.39	36.98	-16.51	-45.36	-46.03	50.97	17.11
36	206	Explosives	48.71	30.43	26.17	-0.39	-15.03	-46.03	50.97	43.87
37	215	Tires And Inner Tubes	30.98	20.68	19.81	-0.39	-13.25	-12.19	11.28	45.64
38	218	Gaskets, Packing And Sealing Devices	23.39	30.90	20.40	-0.52	-14.21	-12.19	11.28	47.78
39	229	Leather Goods, N.E.C.	30.90	56.62	24.24	-0.77	-3.55	-15.80	11.84	91.63
40	233	Brick And Structural Clay Tile	39.77	44.22	35.40	-0.77	-51.23	-10.51	18.92	56.88
41	241	Pottery Products, N.E.C.	56.62	71.75	26.52	-0.77	-6.28	-10.51	18.92	137.33
42	243	Concrete Products, N.E.C.	30.68	38.91	22.75	-0.77	-19.54	-10.51	18.92	61.53
43	250	Minerals, Ground Or Treated	71.75	25.28	30.88	-8.51	-33.33	-10.51	18.92	75.55
44	259	Iron And Steel Foundries	47.98	29.94	16.31	-8.51	-35.66	-100.00	31.51	-49.94
45	269	Brass, Bronze, And Copper Foundries	25.28	33.95	18.49	-8.51	-22.40	-100.00	31.51	-53.20
46	270	Nonferrous Castings, N.E.C.	36.62	48.17	21.49	-1.84	-7.38	-100.00	31.51	-2.94
47	275	Cutlery	33.95	22.99	41.49	-1.84	-15.30	-16.29	25.14	65.01
48	280	Plumbing Fixture Fittings And Trims	48.17	27.36	33.86	-1.84	-14.48	-16.29	25.14	76.79
49	284	Fabricated Plate Work	22.89	32.83	13.70	-1.84	-10.25	-16.29	25.14	41.06
50	295	Plating And Polishing	22.99	45.21	19.00	-1.84	-54.37	-16.29	25.14	14.71
51	298	Ammunition, Except For Small Arms	27.36	39.13	24.41	-1.84	-6.28	-16.29	25.14	66.49
52	299	Small Arms	32.83	24.04	24.14	-1.84	-14.48	-16.29	25.14	48.41
53	303	Pipe, Valves, And Pipe Fittings	45.21	31.65	20.52	-1.84	-10.52	-16.29	25.14	68.73
54	304	Miscellaneous Fabricated Wire Products	39.13	36.80	24.06	-6.46	-14.07	-16.29	25.14	63.18
55	318	Machine Tools, Metal Cutting Types	24.04	32.31	9.91	-6.46	-12.16	-10.57	50.46	37.07
56	319	Machine Tools, Metal Forming Types	31.65	32.57	7.48	-6.46	-16.80	-10.57	50.46	37.87
57	320	Industrial Patterns	36.80	45.81	16.68	-6.46	-3.55	-10.57	50.46	78.71
58	321	Special Dies And Tools And Accessories	32.31	43.90	17.10	-6.46	-9.56	-10.57	50.46	66.72
59	329	Printing Trades Machinery	32.57	28.97	24.16	-6.46	-4.37	-10.57	50.46	64.30
60	330	Food Products Machinery	45.81	28.30	22.74	-6.46	-12.43	-10.57	50.46	67.38
61	339	Electronic Computers	43.90	19.07	27.32	-6.46	-8.06	-10.57	50.46	65.20
62	352	Fluid Power Pumps & Motors	28.97	53.11	16.81	-6.46	-0.82	-10.57	50.46	81.04
63	354	Industrial Machines N.E.C.	28.30	35.02	15.45	-11.13	-6.69	-10.57	50.46	50.37
64	359	Relays & Industrial Controls	19.07	24.52	21.04	-11.13	-19.13	-34.90	36.63	-0.53
65	367	Electric Lamps	53.11	23.88	41.52	-11.13	-37.02	-34.90	36.63	35.46
66	368	Wiring Devices	35.02	30.60	24.26	-11.13	-12.43	-34.90	36.63	31.42
67	369	Lighting Fixtures And Equipment	24.52	23.39	25.79	-11.13	-13.39	-34.90	36.63	14.28
68	371	Phonograph Records And Tape	23.88	35.69	48.27	-11.13	-1.37	-34.90	36.63	60.45
69	376	Printed Circuit Boards	30.60	37.27	24.09	-11.13	-6.69	-34.90	36.63	39.23
70	377	Semiconductors And Related Devices	23.39	19.52	19.29	-11.13	-16.39	-34.90	36.63	-0.21
71	381	Engine Electrical Equipment	35.69	26.59	11.26	-30.92	-19.54	-34.90	36.63	-11.81
72	396	Complete Guided Missiles	37.27	18.56	26.77	-16.96	-5.19	-33.50	50.57	26.94



**Table C-3: Raw Scores for Each Industry and Each Impact, Halifax County  
(Continued)**

Rank Using Raw Score	IMPLAN Code	Sector Title	RAW SCORES								Total Score
			Average Number of Jobs	Average Wage or Salary	Level of Capital Investment	Impacts of Population Growth	Level of Utility Requirements	Cleanliness of Industry	Impacts on Property Values		
73	402	Automatic Temperature Controls	19.52	48.39	22.91	-16.96	-5.05	-18.90	50.57	49.91	
74	404	Instruments To Measure Electricity	26.59	25.48	21.15	-16.96	-5.87	-18.90	50.57	31.49	
75	406	Optical Instruments & Lenses	18.56	30.66	18.60	-16.96	-5.19	-18.90	50.57	26.76	
76	412	Ophthalmic Goods	48.39	42.96	24.76	-0.73	-15.03	-18.90	50.57	81.46	
77	418	Musical Instruments	25.48	46.36	27.62	-0.73	-14.21	-15.55	21.43	68.98	
78	419	Dolls	30.66	45.63	17.38	-0.73	-1.78	-15.55	21.43	75.62	
79	424	Marking Devices	42.96	66.15	34.10	-0.73	-2.60	-15.55	21.43	124.34	
80	426	Costume Jewellery	46.36	46.94	37.40	-0.73	-8.33	-15.55	21.43	106.09	
81	427	Fasteners, Buttons, Needles, Pins	45.63	49.33	26.61	-0.73	-4.10	-15.55	21.43	101.20	
82	428	Brooms And Brushes	66.15	39.41	41.47	-7.66	-3.28	-15.55	21.43	120.55	
83	433	Railroads And Related Services	46.94	24.33	18.53	0.00	-13.25	0.00	58.26	76.55	
84	435	Motor Freight Transport And Warehousing	49.33	38.47	28.71	-4.03	-26.64	0.00	2.77	85.84	
85	438	Pipe Lines, Except Natural Gas	39.41	6.77	100.00	-2.36	-4.64	0.00	49.85	139.18	
86	439	Arrangement Of Passenger Transport	24.33	67.32	32.66	-2.36	-14.21	0.00	58.27	107.74	
87	440	Transportation Services	38.47	38.28	33.52	-12.18	-27.87	0.00	58.27	70.23	
88	441	Communications, Except Radio And TV	6.77	19.10	54.14	-14.04	-7.38	0.00	76.41	58.60	
89	443	Electric Services	38.28	8.88	61.56	-3.10	-30.19	0.00	67.24	75.42	
90	447	Wholesale Trade	19.10	39.81	18.29	-0.76	-25.41	0.00	60.12	51.03	
91	469	Advertising	8.88	47.18	49.38	-0.76	-27.05	0.00	18.48	77.64	
92	470	Other Business Services	39.81	62.32	58.57	-0.76	-14.89	0.00	18.48	145.06	
93	475	Computer And Data Processing Services	21.20	38.94	40.58	-12.25	-9.84	0.00	18.48	78.64	
94	509	Research, Development & Testing	47.18	71.54	22.51	-14.04	-12.02	0.00	96.11	115.17	
95	511	State And Local Electric Utilities	62.32	11.61	65.86	-100.00	-69.54	0.00	67.24	-29.75	
96	512	Other State And Local Govt Enterprises	38.94	23.25	53.08	-100.00	-51.23	0.00	100.00	-35.96	
97	513	U.S. Postal Service	71.54	54.72	-9.33	-100.00	-32.24	0.00	100.00	-15.31	
98	515	Other Federal Government Enterprises	11.61	41.50	29.73	-100.00	-6.15	0.00	100.00	-23.31	
99	520	Federal Government - Non-military	23.25	62.53	0.00	-100.00	0.00	0.00	100.00	-14.22	
100	523	State & Local Government - Non-Educational	54.72	94.74	0.00	-100.00	0.00	0.00	100.00	49.46	

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## Vita

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A handwritten signature in cursive script that reads "Anna M. Cox". The signature is written in black ink and is positioned to the right of the main text block.