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The Ohio Thomas Edison Program: An Economic Impact Study

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**THE OHIO THOMAS EDISON PROGRAM:
AN ECONOMIC IMPACT STUDY**

Prepared for:
THE EDISON CENTERS DIRECTORS' COUNCIL

By:
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EXECUTIVE SUMMARY

This report is based on a study performed at the request of the Edison Center Directors' Council. The study's objective is to measure the economic impact of the Edison Centers on Ohio's economy. The analysis conducted for this study includes estimates of the direct and total impact of the Edison Centers' activities with private industry.

MAJOR FINDINGS

The major findings are divided into three areas: Edison Center Funding, direct impact of the Edison Center's projects, and the total impact of the program.

CENTER FUNDING

- The Edison Centers received a total of \$310 million during the 1994-98 period, of which 64 percent came from the state and federal governments and the remainder from industry for projects with individual companies.
- Federal funding grew most significantly in both dollars and as a share of total revenues: growing from \$2.3 million in 1994 to \$36.5 million in 1998.
- The Centers leveraged 2.3 dollars in federal and industry funding for every dollar of state funding during the period. In addition, the Centers have decreased their reliance on the State of Ohio as a funding source: in 1994 state funds accounted for 45 percent of revenues, by 1998, state funds only accounted for 23 percent of revenues.

DIRECT IMPACTS

- 1,527 projects were used to estimate the impact of the Edison Centers.
- Three variables were used to calculate the economic impact of the Centers: cost savings, increased sales, and jobs (both created and retained).
- Participating firms realized cost savings of \$296.9 million and increased sales of \$708.6 million during the 1994-1998 period. In addition, jobs created and retained during this period equaled 3,346.

TOTAL IMPACTS

- Methodology: the REMI model was used to measure the total economic impact (both benefits and costs) of the Edison Centers on the Ohio economy. The REMI model was chosen because of its structure and reputation. Economic impact is estimated by comparing a baseline REMI forecast of the Ohio economy with an alternative forecast that takes into account the Edison Centers projects. Three variables were changed to create the alternative forecast: increase in cost savings, increased sales and increased created and retained jobs.
- The REMI model estimates the impact of the Edison Centers based on the assumption that the program existed for the time period 1993 to 1998 and assumed that the benefits to firms persisted for four additional years.
- During peak years of Centers' activity, there was a significant increase in total employment in the State of Ohio, reaching 10,590 jobs in 1998.
- Ohio's Gross State Product (GSP), measuring the value of all goods and services produced in Ohio in 1992 dollars, also increased significantly over the period, to a maximum of \$593 million over the baseline estimates in 1998.
- Personal income increased to a maximum level of \$464 million in 1998 and disposable personal income (after tax spendable income) increased to \$386 million. This suggests that Ohioans had more money to spend on other goods and services, creating additional spending rounds in the economy that help to create new jobs, outside of the manufacturing sector.
- Retail Trade and Services, both population serving sectors, benefit from additional manufacturing activities as shown by increased total employment in these sectors.
- In summary, the Edison Centers created an average of 4,628 jobs per year in Ohio and disposable income increased by \$195 million annually. In addition, an average of \$262 million goods and services were produced as a result of the Centers' activities.

INTRODUCTION

STUDY OBJECTIVES

This report is based on a study performed at the request of the Edison Center Directors' Council. The study's objective is to measure the economic impact of the Edison Centers on Ohio's economy. The analysis conducted for this study includes estimates of the direct and total impact of Edison Centers' activities with private industry. The study does not measure the impact of individual Edison Centers, nor does it estimate impact on sub-state geographic regions. The study is based on data provided by each of the Edison Centers following a framework designed jointly by the Urban Center and the Edison Centers.

The first section provides a brief description of the Edison Centers and their combined funding sources. The second section discusses the direct impact of the Edison Centers on Ohio's economy. The third section explains the methodology used to estimate the total economic impact, while the fourth section describes the total economic impact measured in several ways. The last section provides a brief summary and conclusions.

DESCRIPTION OF THE EDISON CENTERS

The following description is taken from a previous study conducted by the Urban Center.¹ Each of the Edison Centers is somewhat different from the others and has its own mission, goals, and objectives.

CLEVELAND ADVANCED MANUFACTURING PROGRAM (CAMP) – CLEVELAND

The Cleveland Advanced Manufacturing Program (CAMP) provides numerous types of services to manufacturing firms, including manufacturing modernization, engineering and technical assistance, and business management services. Many of the services offered by CAMP involve

the application of some of the most advanced technologies being used in manufacturing. These services include assistance with computer process simulation, machinery automation, CAD/CAM/CAE, microfabrication, robotics, and expert systems.

EDISON BIOTECHNOLOGY CENTER (EBTC) – CLEVELAND/CINCINNATI/COLUMBUS

In an attempt to develop a stronger biomedical and biotechnology industry in the State of Ohio, the Edison BioTechnology Center (EBTC) provides numerous services that are focused on specific sectors within the biotechnology industry. These sectors include pharmaceutical, medical devices, and healthcare software companies. Unlike most of the other Edison Centers, a major focus of the EBTC is assisting in the formation of new biotechnology firms. EBTC helps entrepreneurs with general business assistance and strategic planning, and also offers expert advice related to Food and Drug Administration regulations and patent issues.

One way in which the EBTC ensures the future success of the firms it assists is by working closely with other economic development agencies throughout the state. Most notable of these is their relationship with the two Edison Technology Incubators, BioEnterprise (Cleveland) and Bio/START (Cincinnati).

EDISON INDUSTRIAL SYSTEMS CENTER (EISC) – TOLEDO/LIMA/MANSFIELD/SANDUSKY

The Edison Industrial Systems Center (EISC) describes itself as “Industry’s link to technology.” Like CAMP, EISC provides numerous types of services to manufacturing firms. Some of EISC’s services include: general business and marketing assistance; assistance and training on QS 9000 & ISO 9000; use of food manufacturing technology and advanced imaging technology; and various manufacturing engineering and human resource assistance. EISC provides services to a diverse group of industries such as automotive, defense, and food processing.

EDISON MATERIALS TECHNOLOGY CENTER (EMTEC) – KETTERING

The Edison Materials Technology Center (EMTEC) works with industry, academia, and government to develop new industrial materials and improve manufacturing processes. Firms that are involved in the development of these new materials and/or processes are then able to

¹ *An Assessment of the Ohio Edison Program* was prepared for the Ohio Economic Development Advisory Committee, December 7, 1998.

take this knowledge and use it in commercial ventures. Some of EMTEC's major programs include: the Casting Technology Application Program, which focuses on the metal casting industry; the Core Technology Program, which focuses more generally on developing new industrial materials and manufacturing processes; and the Heat Treating Network.

Other types of business and manufacturing assistance are provided through EMTEC Manufacturing Extension. EMTEC Manufacturing Extension provides such services as general business and management assistance, quality training (e.g., ISO 9000), pollution prevention, and waste reduction. This program is funded in part by the national Manufacturing Extension Partnership program.

EDISON WELDING INSTITUTE (EWI) – COLUMBUS

Self-proclaimed as “the largest welding and materials joining engineering consulting company in North America,” the Edison Welding Institute (EWI) provides assistance with all types of material joining. EWI's services include more than just welding. It also includes brazing, soldering, and adhesive bonding of various materials. EWI also provides various degrees of assistance ranging from ‘technical inquiries’ to consulting to contracted research. In addition, EWI provides training in the form of workshops and seminars and sponsors conferences related to material joining.

INSTITUTE OF ADVANCED MANUFACTURING SCIENCES (IAMS) – CINCINNATI

Similar to CAMP and EISC, the Institute of Advanced Manufacturing Sciences (IAMS) provides numerous types of services that are intended to increase the productivity of firms and increase their adoption of new technologies. Services provided by IAMS to improve the manufacturing processes of client firms include: lean production practices, such as total quality management; factory layout design; organizational design; and process mapping, which helps to identify non-value-added activities so they can be eliminated. IAMS also offers special programs related to pollution prevention and machining optimization. Many of the services provided by IAMS are designed to assist firms on a one-on-one basis, however, they also offer various training workshops and seminars that are open to any interested firms.

EDISON POLYMER INNOVATION CORPORATION (EPIC) – AKRON

The Edison Polymer Innovation Corporation (EPIC) focuses exclusively on advancing polymer-related industries in Ohio. The services and assistance that EPIC provides to companies are wide ranging and include activities from business assistance to research and development to design and process improvement. Working closely with industry and university researchers, EPIC provides firms with access to the latest scientific research and technologies used in the polymer industry.

Due to the unique nature of this center, EPIC was unable to provide the type of data necessary for this study. Thus, EPIC was excluded from this study and is not reflected in either the direct or indirect impact sections.

EDISON CENTERS' FUNDING

The Edison Centers receive funding from three primary sources: the State of Ohio, the federal government, and industry. Over the past five years, the Centers' total revenues increased two-and-a-half times. While each of these revenue sources increased over the period, the share and importance of each funding source has also changed.

As seen in Table 1, total funding increased from \$34.2 million in 1994 to \$86.7 million in 1998.² State funding increased by 30 percent, but its share of total funding declined from 45 percent in 1994 to 23 percent in 1998. While funding from industry and other sources grew at a larger rate than state funding, as a share of total funding it also declined. Industry funding almost doubled, but its share declined from 48 percent to 35 percent. The funding source that increased most significantly in both dollars and as a share of total revenues is federal funding. Federal funding grew from \$2.3 million in 1994 to \$36.5 million in 1998, accounting for 42 percent of all Edison Centers' revenues last year. The federal sources of funding include the National Institute for Standards and Technology's (NIST) Manufacturing Extension Partnership as well as research funding from numerous federal agencies.

Table 1: Total Edison Center Funding by Source by Year (\$=Millions)

² Funding data were provided by the Edison Centers

	1994	1995	1996	1997	1998	Percent Change 1994-1998	Total 1994-1998
State of Ohio	15.4	18.0	18.7	22.0	20.0	30%	94.1
Federal	2.3	17.8	18.1	29.3	36.5	1487%	104.0
Industry/Other	16.5	18.2	22.9	23.6	30.2	83%	111.4
Total	\$ 34.2	\$ 54.0	\$ 59.7	\$ 74.9	\$ 86.7	154%	\$ 309.5

DIRECT IMPACTS

This section discusses the direct economic impacts of the Edison Centers on the State of Ohio³. The direct impacts are based on assistance to firms by individual centers. The direct economic impacts on the State of Ohio are estimated by using a single set of “impact indicators” throughout this analysis. The annual data for the impact analysis focus on three main indicators: changes in employment, changes in sales, and changes in savings.⁴ All data collected is at the project level and then summarized to major industries which consist of two-digit Standard Industrial Classification (SIC) codes. Projects were assigned to years based on their reported project end date. In order to allow for an expected time lapse between the project end date and the realization of impacts, projects that ended between January 1 and June 30 were assigned to their respective calendar year, while projects that ended July 1 to December 31 were assigned to the following year.⁵

PROJECTS AND COSTS

There were 1,527 projects from the seven Edison Centers that were used to estimate the impact of the program. Listed in Table 2 are “firm costs”, which are the participating firms’ fees paid directly to the Center (center fees) and other costs required to implement the suggested changes (other fees). Firm costs associated with Edison Center programs during the research study

³ These are aggregate impacts reported by the Centers that are based on individual firm or establishment survey responses. Due to differences among Centers in data collection and reporting, these are only partial impacts of the programs. Data collection is limited by two conditions. First, some Centers have not been collecting data in a manner consistent with this type of analysis, and second, some Centers’ activities and missions are not consistent with this type of analysis.

⁴ The data was supplied by individual Edison Centers.

⁵ The 1998 data in this section’s tables include 12 projects that ended between July and September 1998 (the last month of available data).

period totaled \$135.2 million -- \$12.7 million in center fees and \$122.5 million in other costs. Both center fees and other costs have generally increased during this period, with a significant increase in both fees for 1998.

**TABLE 2: Total Firm Program Costs
(nominal dollars)**

	Center Fees	Other Fees
1993	N/A	N/A
1994	1,934,591	35,875,811
1995	2,328,810	25,584,611
1996	1,735,089	10,212,870
1997	1,663,539	9,986,343
1998	5,062,376	40,882,436
Total	12,724,405	122,542,071

The distribution of projects classified by industry groups is shown in Table 3. Of the 1,527 projects, 88 percent (1,346 projects) were in the manufacturing sector. The Services sector, with 109 projects, accounted for slightly over seven percent of all projects, while Wholesale Trade accounted for nearly two percent.

TABLE 3: Number of Projects by Industry: 1993-99

Industry	Number of projects	Percent of Industries
Mining	2	0.13%
Construction	6	0.39%
Manufacturing		
Durables	1,088	71.25%
Nondurables	258	16.90%
TCPU	3	0.20%
Wholesale	29	1.90%
Retail	15	0.98%
FIRE	8	0.52%
Services	109	7.14%

The Edison Centers' Impact

Government	9	0.59%
TOTALS	1,527	100%

As manufacturing accounted for the majority of the projects, Table 4 provides a more detailed look at this sector. Classified by two digit SIC, Fabricated Metal Products had the largest share of manufacturing projects, with 20 percent, followed by Industrial Machinery and Equipment, with 18 percent.

Table 4: Number of Manufacturing Projects by Industry 1993-1999

SIC	Manufacturing Industries	Number of Projects	Percent of Industries
20	Food and Kindred Products	12	0.89%
22	Textile Mill Products	3	0.22%
23	Apparel and Other Textile Products	13	0.97%
24	Lumber and Wood products	9	0.67%
25	Furniture and Fixtures	14	1.04%
26	Paper and Allied Products	30	2.23%
27	Printing and Publishing	28	2.08%
28	Chemicals and Allied Products	60	4.46%
29	Petroleum and Coal Products	3	0.22%
30	Rubber and Misc. Plastics Products	105	7.80%
31	Leather and Leather Products	2	0.15%
32	Stone, Clay, and Glass	41	3.05%
33	Primary Metal Industries	210	15.60%
34	Fabricated Metal Products	275	20.43%
35	Industrial Machinery and Equipment	247	18.35%
36	Electronic and Other Electronic Equipment	97	7.21%
37	Transportation Equipment	74	5.50%
38	Instruments and Related Products	40	2.97%
39	Misc Manufacturing Industries	83	6.17%
	Total	1346	100.00%

DIRECT INDICATORS OF ECONOMIC IMPACT

Three variables were used to calculate the economic impact of the Edison Centers: cost savings, increased sales, and jobs (both created and retained). Firms reported first-year change and change during the following four years for some or all of these variables.

Table 5 reports on the annual direct impact of the Edison Centers in term of these variables. Firms reported, separately, first year cost savings and cost savings for years two through five. The total statewide cost savings from projects within the first year of a firm's implementation of an Edison Center program amounted to \$81.6 million, while \$215.2 million was reported as savings for the second through fifth year.⁶ Estimates of increased sales attributed to Edison Centers are also described in Table 5. As with cost savings, firms reported sales increases for the first year, and increases accruing in the four subsequent years. In the first year, sales increased by \$139.3 million, and an additional \$569.2 million was estimated by respondents in total sale increases for years two through five. It can also be noted that there was a significantly larger increase in sales than in cost savings between 1997 and 1998. This increase is a combination of improved data collection methods as well as an actual rise in sales.

Table 5 also includes the estimated number of jobs created or retained as a direct result of Edison projects. The projects resulted in the creation of 2,055 jobs and the retention of 1,291 jobs. It should be noted that retained jobs are valued the same as created jobs in this study. This is a logical approach since additional investment is required to keep existing jobs competitive. In addition, most states have increased their attention to existing manufacturing job retention. While some firms did not generate new jobs as a result of Center programs, the reported retained jobs were an effect of Center programs and are equally important.

Table 5: Reported Returns from the Edison Center's programs

	Cost Savings (nominal \$)		Sales (nominal \$)		Jobs	
	1st Year	Cumulative Years 2 through 5	1 st Year	Cumulative Years 2 through 5	Create	Retained
1993	N/A	N/A	N/A	44,292	N/A	N/A
1994	20,260,242	47,320,172	30,267,499	120,785,704	604	123
1995	24,733,695	63,202,432	15,712,392	59,169,568	114	100
1996	13,463,098	37,815,452	16,566,500	85,099,500	86	31
1997	6,429,217	20,541,808	17,133,398	79,382,992	125	154

⁶ Reported savings are in nominal or current dollars.

The Edison Centers' Impact

1998	16,783,407	46,347,440	59,652,560	224,793,920	1,126	884
Totals	81,669,660	215,227,304	139,332,349	569,275,976	2,055	1,291

In the aggregate, while firms incurred a cost of \$135.2 million to implement Edison Centers' projects during the period 1994-1999, participating firms realized cost savings of \$296.9 million and increased sales amounting to \$708.6 million. Total jobs created and retained equaled 3,346. Total savings and sales increases were \$1.005 billion for all years, which suggests a rough measure of 7.4 dollars in sales and savings for each dollar spent by firms on Center programs. A note of caution: this ratio is only an indicator and should be taken as such. It is not intended to imply or to be used as a factor of return on investment.

METHODOLOGY

This section describes the REMI Model,⁷ the model used to measure the total economic impact of Edison Centers on the state's economy. It explains the assumptions used in these estimates and the way in which economic impact is measured.

THE REMI MODEL

For this study, the REMI model was used to measure the total economic impact of Edison Centers on the Ohio economy. More specifically, REMI Policy Insight, the newest version of REMI's software, was chosen for this study because of its structure and reputation. The REMI model shares two underlying assumptions with mainstream economic theory: households maximize their utility and producers maximize profits. The REMI model includes hundreds of equations that describe cause-and-effects relationships in the economy, going beyond an input-output model. Figure 1 provides a simplistic presentation of the REMI model.

The Output block in Figure 1 includes all the inter-industry relationships that are in an input-output model.⁸ The Labor and Capital Demand block indicates how labor and capital requirements depend on their relative prices as well as on output.⁹ Population and Labor Supply create demand for products from the Output block and also determine wages in the labor market.¹⁰ The feedback (double arrow between the Population and Labor Supply block and the Wages, Prices, and Profits block) suggests that economic migrants respond to labor market conditions. Demand and supply interact in the Wage, Price, and Profit block, which influences the Market Shares block, and that, along with components of demand, determines Output.^{11,12}

⁷ REMI stands for Regional Economics Models, Inc. located in Amherst, Massachusetts.

⁸ State and local government spending, investment, exports, consumption, and real disposable income influence the Output block.

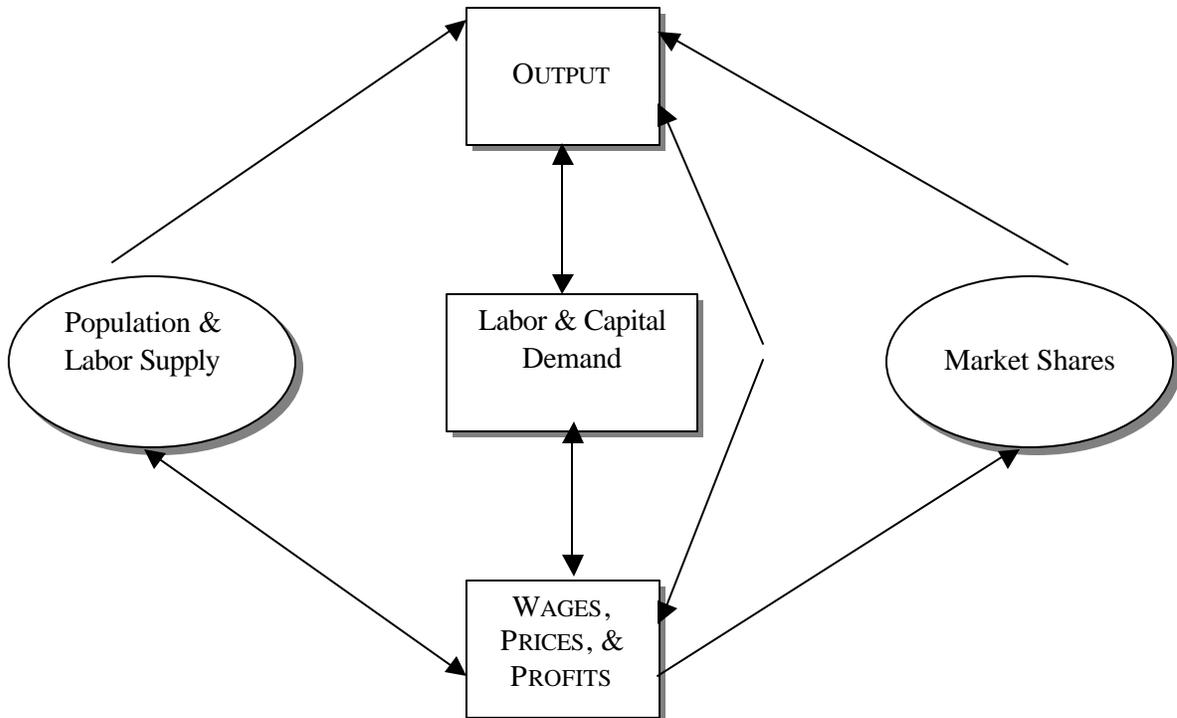
⁹ The Labor and Capital Demand block depends on employment, labor/output ratio, and optimal capital stock.

¹⁰ The Population and Labor Supply block depends on population and migration.

¹¹ Many factors enter the Wage, Price, and Profit block. These include employment opportunity, wage rate, consumer price deflator, real wage rate, production costs, profitability, industry sales price, and housing price.

¹² The Market Shares block refers to the shares of both local and external markets.

Figure 1: Overview of the REMI model

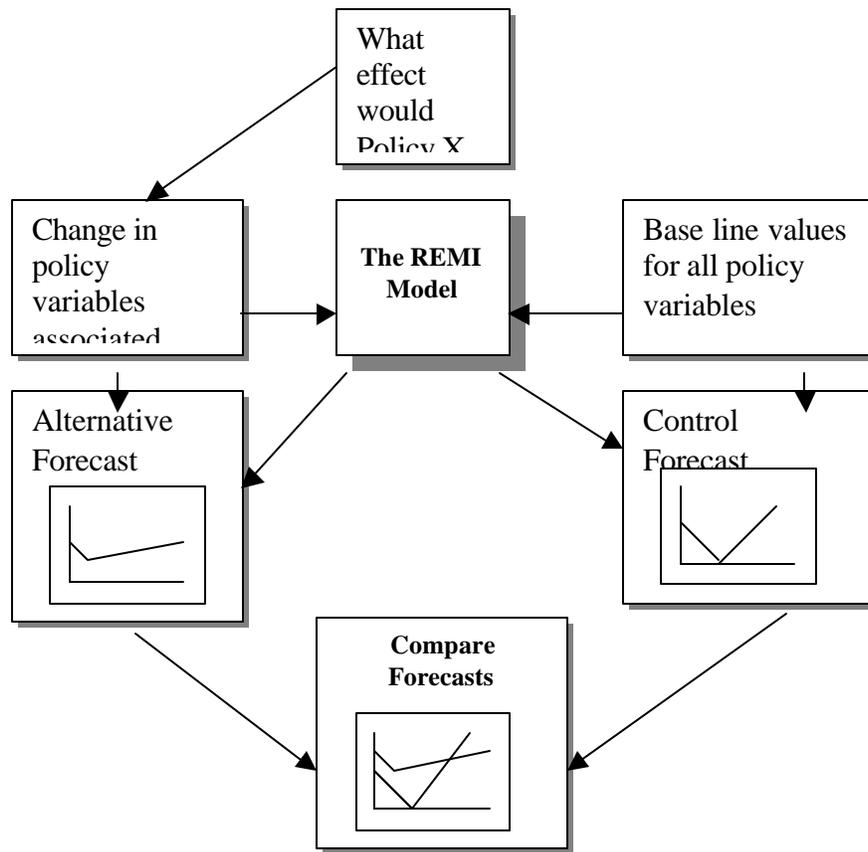


Source: REMI Policy Insight, User Guide.

The REMI model uses extensive data sets to estimate key inter-relationships of the economy. REMI builds customized regional models using data from the Census Bureau, Bureau of Labor Statistics, Bureau of Economic Analysis, Department of Energy, and other public sources. The model provides long-term projections with general equilibrium properties that are called control forecasts.

When a REMI model is used to estimate an economic impact, one needs to understand how the model works and how the model variables interact with each other. Figure 2 shows how the impact is measured for a policy change called “Policy X”. The figure illustrates that the baseline forecast (or control forecast) is compared to an alternative forecast that is based on the changed policy. The difference between the two forecasts provides an estimate of the total economic impact.

Figure 2: Measuring Economic Impact in REMI



Source: REMI Policy Insight, User Guide

ASSUMPTIONS

This research emulates a model developed by Dr. Mark Ehlen of the National Institute for Standards and Technology (NIST) in Gaithersburg, Maryland to evaluate the economic impact of Manufacturing Extension Partnership (MEP) Centers. NIST oversees the national network of more than 70 MEP Centers that are organized as independent non-profit entities that offer products and services that meet the specific needs of a region's local manufacturers. These Centers provide solutions to production problems, such as Y2K and implementation of new process and capital technologies, as well as offering general assistance in reversing declining

conditions such as sales and productivity.¹³ Three of the Edison Centers -- CAMP, IAMS, and EISC -- serve as MEP Centers.

As part of their program evaluation, NIST developed a system of measuring the economic impact of MEP activities on a state or a regional economy. Data is collected using surveys completed by MEP clients. These evaluations are tabulated and aggregated as inputs into the REMI model, as discussed in the previous section. A standard set of inputs is generally not available from all MEP centers because there is often a lack of consistent evaluation and measurement processes available. To provide a system of evaluation and measurements, NIST developed a series of measures for the evaluation process. Some measures are routinely collected by each of the MEPs. However, some Centers collect only one of the measures and others collect multiple measures. To overcome nonstandard data collection, NIST hierarchically ranked its measures in order of their preference for use in the evaluation and simulation. This ranking is required so that only one measure captures the benefits of a project and eliminates double counting of benefits that could result if more than one indicator was used.

MEASURING THE ECONOMIC IMPACT OF EDISON CENTERS

Similar to the methodology used in the NIST study of Manufacturing Extension Programs, data was collected by Edison Centers to estimate the economic impact of their programs on the Ohio economy. All observations used in this analysis use information collected and reported by firms that participated in Edison Center projects. Each Center's performance indicators that are later used as inputs into the REMI model are the sum of reported benefits by constituent firms using Center products and services. Only those projects for which adequate reported data was available are incorporated into this evaluation. One Center, EPIC, was engaged in client projects but insufficient data precluded it from participating in this impact study. Additionally, the rest of the centers all had projects which were excluded due to insufficient data.

The study uses three variables to estimate the economic impact of the Edison Centers on the economy of the State of Ohio. Each of these variables was evaluated and a ranking scheme

¹³ For additional information on MEP and NIST, please see their web site at <http://www.mep.nist.gov/>

devised based on a discussion with and recommendation from NIST's Mark Ehlen. A ranked order of preference was required to avoid any double counting of benefits where more than one measure was reported for an Edison Center project. The following ranking scheme was adapted for this analysis:

- Increased sales (in nominal dollars)
- Change in employment
- Increased savings to the firm (in nominal dollars).

Given that the REMI model is a dynamic longitudinal model that provides forecasts of impacts into the future, it was necessary to assume that the benefits (employment, savings and sales) realized by firms participating in Edison Center projects would persist into the future for some period of time. It was assumed that these benefits persisted for four additional years. For example, if a Center project reported a change in employment in 1998, that employment would also be used in the model for 1998 through 2002. Thus, the estimates of the total economic impact of the Edison Centers on the Ohio economy as discussed in the next section are forecasted to 2003.

One of the limitations of the REMI model is that it is not possible to alter its historical data files. Consequently, we are unable to synchronize the data collected by the Edison Centers with the REMI model. In the REMI model used for this analysis, 1995 was its last year of history and 1996 was the first forecast year. Therefore, to assess the impacts of the 1993 through 1995 data, all of the data was shifted three years forward and 1996 became the first year of inputs and estimates. This procedure introduces the potential for some minor level of estimate error, as the impacts of inputs may be varied across time. It is expected, however, that the impacts will be minimal for two reasons. First, although the model solves multiple equations simultaneously in a number of modules, it is essentially a linear model. Second, the time periods examined are small. It is expected that macro and micro economic growth will be similar between and across the two time periods, given that the economy has performed consistently during these years. Consequently, the similarity in modeling periods suggests that the estimates or impacts should be reliable and similar for both periods.

TOTAL ECONOMIC IMPACT

This section describes the total estimated economic impact on Ohio's economy as a result of the combined reported activities of the Edison Centers. The primary impacts that are used in the assessment are changes in employment, income, and Gross State Product (GSP). As discussed previously, the estimated impact is calculated as the difference between the control forecast and an alternative forecast that is based on the changes resulting from the activities of the Edison Centers. It is postulated that these changes would not have occurred without the programs offered by the Centers. Total impact is reported through 2003, the last year in which the direct effects of the projects were assumed to have persisted. The U.S. economy is currently in its eighth consecutive year of an economic expansion. This is the longest peace time expansion in history. While no downturn is generally predicted by conventional forecasters, the probability of such an event is likely. Recent occurrences external to the U.S. economy, such as the Asian Crisis, the Russian financial default, and the recent dumping of steel in the U.S. economy, have a critical effect on the performance of the State economy. Predicting these occurrences and the impact of such effects is nearly impossible.

EDISON CENTERS' IMPACT ON OHIO'S EMPLOYMENT

The REMI model simulations suggest that, due to the activities of the Edison Centers, the state's total employment increased by 237 jobs in 1993, rose to a high of 10,590 additional jobs in 1998, and would increase by 5,575 jobs in 2002 (see Table 5). While benefits continue to accrue from the programs in 2003, their impact is minimal due to the relative small size of their contribution. The negative trends for values in 2003 are somewhat mitigated by the persistent contribution of benefits received from 1999 Center programs. It should be stressed that this study measures the Centers' impact only until early 1999 (which means direct impact through 2003). Thus, it assumes no impact after these years; the decreasing employment impacts reflect this.

EDISON CENTERS' IMPACT ON OHIO'S GROSS STATE OUTPUT

Similar to total impact on employment, Table 5 shows that Gross State Output (GSP) increased due to Edison Centers' activities by almost \$10 million in 1993, growing to \$593 million in 1998, and then rising at a smaller rate to \$341million in 2002 (over the baseline forecast).¹⁴ GSP is then projected to decline, due to Edison Center activities, in the years 2002-2003.

EDISON CENTERS IMPACT ON OHIO'S PERSONAL INCOME

Personal income follows a similar pattern as GSP, adding an additional \$7 million in 1993, \$464 million in 1998, and then a gradual decline to an additional \$34 million in income in 2003. It is important to note that while other measures become negative at some point, wages do not decline. This outcome is consistent with economic labor theory, which explains that wages are slow to adjust to shifts in the demand for labor. This is because the labor force expects to continue in its current jobs for some time at preset wages that are renegotiated periodically but not frequently. Thus, while there could be a reduction in the demand for labor, wages do not correspondingly adjust downward.

¹⁴ Dollars for GSP and income are reported in 1992 constant dollars, which controls for inflation. The use of constant dollars shows real changes in outcome without concern for estimating the impact of inflation.

TABLE 6: Summary of Economic Impacts

	1993	1994	1995	1996	1997	
Total Employment	237	2,399	3,127	3,426	4,291	
Private Non-Farm Employment	232	2,354	3,027	3,280	4,091	
Gross State Product (millions of 1992\$)	10	119	162	181	230	
Personal Income (millions of nominal \$)	7	84	122	145	190	
Disposable Personal Income (millions of nominal \$)	6	69	102	121	158	
	1998	1999	2000	2001	2002	2003
Total Employment	10,590	8,342	7,199	6,565	5,575	-845
Private Non-Farm Employment	10,250	7,875	6,684	6,015	5,009	-1,316
Gross State Product (millions of 1992\$)	593	478	420	391	341	-41
Personal Income (millions of nominal \$)	464	414	388	375	340	34
Disposable Personal Income (millions of nominal \$)	386	346	325	315	287	35

Therefore, while the number of employees may decline, the long term impact of increasing incomes in a competitive labor market is to ratchet all wages upward. That process is expected to continue even after the labor market softens. Similar trends are exhibited with disposable personal income (after tax income) beginning with almost \$7 million in additional income in 1993, over \$386 million in 1998, and remaining positive through 2003 (\$35 million).

In summary, since employment is directly related to output, the two series of data increase in value through 1998, then the increases begin to decline but remain positive, relative to the baseline forecast, through 2002. Employment and GSP become negative in the final periods of assessment. Income, due to the slowness of wages to adjust to shifts in demand for labor, remains positive over the entire period, presumably from the direct impact of bidding up wages in the affected industries. Wages in comparable and complementary industries also are sticky downward as firms compete for workers in tight labor markets.

ECONOMIC IMPACT BY INDUSTRY

This section details the impacts of the Edison Centers on specific industrial sectors within the Ohio economy.¹⁵ Table 7 shows that, due to the Edison Centers programs, about one third of job growth occurs in the manufacturing sector, when compared to a forecast model without the Edison Centers. Peak manufacturing job growth occurs in 1998, when total employment increases by 3,539 manufacturing jobs. After 1998, the impact of the Centers on manufacturing employment declines through 2002 (with 1,848 total manufacturing jobs), due to the reduction of benefits associated with Edison Center activities. Within the manufacturing sector, durable- good manufacturers are the largest contributors to employment growth. On a proportional basis, manufacturing accounts for 30 to 35 percent of total employment growth during the studied period.

The combination of retail trade and services accounts for an additional 4,543 jobs in 1998. Both are population serving and, consequently, when manufacturing employment grows, it is expected that these sectors will also expand. Retail trade accounts for 15 to 20 percent of total employment growth. The Services sector accounts for between 24 and almost 31 percent of total employment growth between 1994 and 2002.

TABLE 7: Employment Impacts by Industrial Sector

	1993	1994	1995	1996	1997
Manufacturing	48	704	1007	1119	1412
Durables	38	620	887	975	1242
Non-Durables	10	84	120	144	170
Non-Manufac	184	1650	2020	2161	2679
Mining	1	9	11	13	26
Construction	19	157	190	199	253
Trans/Pub Util	8	222	243	251	284
Fin/Ins/Real Est	16	112	137	145	177
Retail Trade	47	422	539	572	708
Wholesale Trade	8	112	149	163	209
Services	84	602	733	797	998
Agric/For/Fish Serv	2	15	18	20	24

¹⁵ Sectors are aggregations of two-digit industries as follows: Transportation, Communication and Public Utilities (40-49), Wholesale trade (50 and 51), Retail trade (53-60), Finance, Insurance, Real Estate (60-67), Services (70-89), Agriculture, Forestry and Fishing (1-9), Mining (10-14), and Construction (15-17). Manufacturing (20-39) is divided into durable and non-durable products.

The Edison Centers' Impact

Total Government	5	45	100	147		200
Total Employment	237	2399	3127	3426		4291
	1998	1999	2000	2001	2002	2003
Manufacturing	3539	2799	2403	2188	1848	-243
Durables	2431	1784	1448	1277	977	-173
Non-Durables	1108	1015	955	910	871	-70
Non-Manufact	6708	5076	4281	3827	3162	-1073
Mining	53	42	36	32	18	-8
Construction	646	483	387	328	242	-191
Trans/Pub Util	513	283	242	219	180	-57
Fin/Ins/Real Est	402	306	251	221	181	-60
Retail Trade	1685	1271	1047	926	750	-235
Wholesale Trade	492	377	317	281	221	-67
Services	2858	2269	1964	1788	1544	-443
Agri/For/Fish Serv	58	44	36	32	26	-12
Total Government	346	467	515	550	566	471
Total Employment	10590	8342	7199	6565	5575	-845

While other sectors show employment gains, their impact tends to be small and none contributed more than 10 percent to the total employment change.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This report describes the estimated direct and total economic impacts of the Edison Centers on Ohio's economy. Direct impacts are derived from data reported by the Centers including cost savings accrued to the participating firms and increases in firms' employment and sales.

Forecasted total impacts are measured in terms of changes in Ohio's employment, Gross State Product, and personal income.

SUMMARY OF MAJOR FINDINGS

The Edison Program received a total of \$310 million in funding during the 1993-98 period, of which 64 percent came from the state and federal governments and the remainder from industry for projects with individual companies. These streams of revenues resulted in the following total impacts:

- During peak years of Centers' activity, there was a significant increase in total employment in the State of Ohio, reaching 10,590 jobs in 1998.
- Similarly, GSP increased significantly over the period of the Centers' activities, to a maximum of \$593 million over the baseline estimates.
- Personal income increased to a maximum level of \$464 million in 1998 and disposable personal income (after tax spendable income) increased to \$386 million. This suggests that Ohioans had more money to spend on other goods and services, creating additional spending rounds in the economy that help to create new jobs outside the manufacturing sector.
- Retail Trade and Services, both population-serving sectors, benefit from additional manufacturing activities as shown by increased total employment in these sectors.

Table 8 summarizes the total economic impacts of the Edison Centers from their activities during the 1993-98 period.

TABLE 8: Summary of Economic Impacts

	Total (1993-2003)	Annual Average
Total Employment	50,906	4,628
Private Non-Farm Employment	47,501	4,318
Gross State Product (millions of 1992\$)	2,884	262
Personal Income (millions of nominal \$)	2,563	233
Disposable Personal Income (millions of nominal \$)	2,150	195

Based on the impacts presented in Table 6, Table 8 reports that the Edison Program created an average of 4,628 jobs per year in Ohio and disposal income in the State increased by \$195 million annually. On average, additional \$262 million of good and services were produced in Ohio as a result of Edison Centers' activities.

CONCLUSIONS

Based on the analysis performed for this study, the Urban Center concludes that the Edison Centers contribute significantly to the Ohio economy in terms of employment, output, and income relative to the amount of public money invested in these Centers.

Analyzing the Edison Centers' revenues leads to the following conclusions:

- State of Ohio funding: the Centers leveraged 2.3 dollars in federal and industry funding for each dollar of state funding during the 1993-1998 time period.
- Public versus private sector funding: private sector funding accounted for 36 percent of all funding over the whole period. In other words, the Centers received 1.8 dollars of public funding for each dollar of private sector funding.
- The Edison Centers have decreased their reliance on the State of Ohio as a funding source: in 1994 state funds accounted for 45 percent of the Centers' revenues, by 1998, state funds accounted for only 23 percent of revenues.

As guided by the study's objectives, the study did not analyze individual Centers and did not capture the Centers' role in research and development.