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**KTEC OUTCOMES, 1989-1995**

An Evaluation of the  
Kansas Technology Enterprise Corporation  
Using the ROPI Methodology

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## EXECUTIVE SUMMARY

- This report provides an evaluation of the Kansas Technology Enterprise Corporation (KTEC), both as a whole and with respect to its major component agencies. KTEC and its component agencies are economic development programs of the State of Kansas that focus on technology transfer.
- This report uses the Return On Public Investment (ROPI) method described in a previous study of KTEC [Burruss and Oslund, 1994]. The current report is based on completely new surveys of client firms. The data cover the years 1987 through 1994.
- This report analyzes 14 different indicators of the social benefits of KTEC programs, plus an over-all weighted indicator, for each KTEC agency and for KTEC as a whole. The indicators include income, jobs, business tax revenues, work force experience and education (human capital), business start-ups in manufacturing, new patents granted, and so on. Each indicator is analyzed in several different ways.
- This report analyzes costs as well as benefits for each of the 14 indicators. A “cost” is defined as the income, jobs and other positive outcomes that are forgone when any agency uses up budgetary dollars. In other words, Kansas had to forgo the jobs and other positive multiplier effects it could have received, had it simply handed KTEC budgetary dollars back to Kansas citizens. These forgone benefits are what is called an “opportunity cost.”
- In terms of benefits that have already been realized from KTEC activities, KTEC as a whole was found to be quite productive. The theoretically best way to measure KTEC's effect on an indicator is to calculate the ratio of benefits denominated in terms of that indicator, to costs denominated in terms of the same indicator. These ratios are referred to as ROPIs. In each case, the cost denominator refers to what was foregone because we did not simply distribute KTEC dollars to the taxpayers.
- Here are the lower-bound ratios of benefits obtained to costs (i.e. benefits forgone) for some of the indicators:
  - In terms of jobs in Kansas, KTEC generated at least 5.8 jobs for every job forgone.
  - In terms of Kansas income, KTEC generated at least 3.0 dollars of income for every dollar of income forgone.
  - In terms of Kansas business taxes, KTEC generated at least 4.9 dollars of revenues for every dollar of business tax revenue forgone.
  - In terms of workforce skills in Kansas, KTEC generated at least 6.8 years of experience and education for every year forgone.

- In terms of patents granted in Kansas, KTEC generated at least 41 patents for every patent forgone.
- In terms of a weighted indicator based on 14 statewide results of economic development in Kansas, KTEC generated an increase of at least 14% of the aggregate indicator for each 1% forgone.

These ratios are “Realized ROPI” values because they do not include benefits that can be anticipated in the future from KTEC dollars previously spent. “Anticipated ROPIs” that included future benefits would be substantially larger than these Realized ROPIs.

- Here are some measured rates showing the overall effectiveness of KTEC budgetary dollars. For every \$1M the State of Kansas has spent on KTEC programs, KTEC has already generated a *net* outcome (i.e., benefits less costs) of at least:
  - 65 jobs lasting one year in Kansas (or the equivalent, such as 5 jobs lasting 13 years. (These jobs are counted only if they are filled by persons already living in Kansas);
  - \$2.2M dollars of Kansas income;
  - \$100,000 dollars of Kansas business tax revenues;
  - about 1/4 of a new patent granted in Kansas; and
  - 250 years of workforce experience and education added to the Kansas work force.
- All estimates reported above are lower bounds that are highly conservative in a number of respects:
  - Anticipated future benefits are ignored
  - Benefits are discounted by an “attribution rate” (i.e., multiplied by the share of credit that goes to KTEC, as judged by the client firm).
  - Benefits and costs are discounted over time at a relatively high rate of 12% per year. (Since costs occur before the benefits are accrued, this practice significantly reduces the ratio of benefits to costs.)
  - *All* KTEC costs are included (e.g., costs are included for projects just getting started that have no benefits as yet).
  - Benefits are counted only from verified outcomes (e.g., outcomes verified by surveys actually returned by clients of the program). There is no correction for survey non-response.
  - Benefits received by non-residents of Kansas were omitted.
- The ROPI model includes multiplier effects. This would not be viewed as conservative. However, use of multipliers in this report does not lead to a particular bias in either direction, because multipliers are used in the cost denominator as well as in the benefit numerator. Multipliers are simply used as a best-estimate assumption—their omission would seriously distort the picture of KTEC’s effects on different parts of the Kansas economy.



- With respect to the particular KTEC agencies examined, it was found that every agency has been positively productive with respect to every indicator. The NIAR agency has been the most productive in a number of important respects, including generating income and jobs, and especially in generating good jobs that pay well or have high amounts of human capital. The Ad Astra agency has been particularly effective at encouraging manufacturing startups. The MAMTC agency has been particularly effective at leveraging federal dollars. The AMI, CECASE, and CDDP agencies lag behind the other agencies on most of the indicators. However, any relative rankings should be viewed with caution, because they could be sensitive to unknown benefits excluded due to survey non-response. CDDP, for example, scored much higher in the previous study, mainly because of a single large firm that responded to that survey but not on the current survey.
- As in any evaluation, a critical issue is “attribution”—i.e., deciding whether full credit for actually causing all of the outcomes can be attributed to KTEC. For example, it is generally believed that most economic development programs provide subsidies in some cases to firms that would have expanded or relocated even without them. Attribution was studied by directly asking client firms what share of the credit they thought KTEC deserved for the jobs and income they created. In addition, a completely independent study of attribution was made using Unemployment Compensation data. These data show employment and payroll for all firms in Kansas during 1987-1995. It was found that firms assisted by KTEC typically grew faster and survived longer than other firms, even after controlling for type of industry and for growth rate prior to KTEC’s intervention. These findings confirm the positive findings from direct surveys of firms.
- A comparison with other studies found that KTEC has generally been at least as effective as, and often more effective than, other economic development programs both in Kansas and elsewhere. KTEC was also found likely to be more effective on average than economic development-related tax exemption programs in Kansas.

# 1. INTRODUCTION

This report provides an evaluation of Kansas Technology Enterprise Corporation, or KTEC, and also evaluates several of its individual programs. The report uses the ROPI (Return On Public Investment) methodology. The ROPI method was described and applied in two previous reports, one by Burress, El-Hodiri, and Nayaranan [1993], and the other by Burress and Oslund [1994]. For additional description, see Burress [1996, 1997], and Burress and Oslund [1996]. The present report uses a new data set, constructed during 1995 and covering KTEC activities through Fiscal 1993-94. This report also makes several modifications in the methodology, which are described subsequently.

## **Purpose**

This report has two general goals. First, it is intended to inform legislators, policy-makers, and citizens about the over-all effectiveness of the KTEC program. Second, it is intended to assist KTEC in the management of its several programs by comparing the particular strengths and weaknesses of each program.

This report focuses entirely on observable outcomes, in relation to dollar inputs. It does not examine what goes on inside the activities of the various KTEC programs. (In other words, ROPI is an “outcome” not a “process” evaluation method.) Therefore, this report cannot examine in detail what changes in the conduct of its various activities might make KTEC more effective. But it does quantify the actual effectiveness of KTEC and of its individual programs, and those results could suggest possible changes in the various activities.

## **The nature of KTEC**

KTEC is an economic development agency established by the State of Kansas and focusing on technology development in Kansas. KTEC is governed by a 20-member board of directors composed of financial, business, academic, and government leaders. To stimulate innovation and its commercialization, KTEC:

- Finances collaborative research and technology transfer between academic institutions and industry through the Applied Research Matching Fund;
- Finances five Centers of Excellence at four state universities for basic and applied research and technology transfer;
- Provides seed capital financing for new and emerging technology-based Kansas industry through the Ad Astra Fund;
- Provides matching grants for the federal Small Business Innovation Research program;
- Provides technical information and referral services to new, emerging or mature businesses;

- Targets the retention and expansion of current Kansas businesses through a state-wide industrial liaison program; and
- Is working to accelerate the rate of commercialization of products and processes through Commercialization Corporations throughout the state.

At the time this evaluation was begun, KTEC also assisted community and vocational technical institutions in acquiring state of the art equipment for training and retraining the local workforce; but this program transferred to Kansas Department of Commerce and housing in FY1997.

### **KTEC agencies being evaluated**

The following KTEC agencies are examined in this report.

#### *Centers of Excellence*

The Centers of Excellence program includes five Centers at four of the public universities of Kansas. This program is a vehicle for meshing expertise, equipment and facilities for basic and applied research and development efforts. Each center offers its own area of expertise. The Centers and their areas of expertise are:

- NIAR (the National Institute for Aviation Research) at Wichita State University: aviation.
- AMI (the Advanced Manufacturing Institute) at Kansas State University: manufacturing processes.
- HBC (the Higuchi Biosciences Center) at the University of Kansas: pharmaceuticals and biotechnology research.
- CECASE (Center of Excellence for Computer-Assisted Systems Engineering) at the University of Kansas: computer-aided design. (CECASE was recently merged with another agency at KU, its focus was shifted to communications and information management, and is now known as the Information and Telecommunications Technology Center, or ITTC.)
- CDDP (Center for Design, Development, and Production) at Pittsburg State University: woods, plastics and printing processes.

#### *MAMTC (Mid-America Manufacturing Technology Center)*

In 1992, KTEC successfully competed for and won a National Institute of Standards and Technology (NIST) funded Manufacturing Technology Center. This center is nationally known as MAMTC—the Mid-America Manufacturing Technology Center. MAMTC's focus is technical consultation, training, demonstrations, and assistance to small and medium-sized manufacturers. It originally covered Kansas, western Missouri, and Colorado, and has been expanded to include

Wyoming and most of the rest of Missouri. (The evaluation included in this report covers MAMTC activities in the state of Kansas only.)

#### *ARMF (Applied Research Matching Fund)*

The goal of the Applied Research Matching Fund program is to assist Kansas businesses in overcoming technical and financial hurdles in new product development. A product must apply current scientific and technological knowledge and lead to new developments that can have a positive impact upon the Kansas economy. KTEC funds 40 percent of the research, with the participating company covering the remaining 60 percent of the costs. If the product becomes commercially successful, KTEC receives a royalty on product sales.

#### *Ad Astra Fund*

Early stage or start-up firms that utilize advanced technologies have tremendous potential for growth. They also have tremendous needs for capital. Thus in 1988 the state worked through KTEC to develop a private limited partnership with Campbell-Becker Inc., creating a seed capital fund known as Ad Astra. The portfolio is made up of high-quality, high-return investments whose technology has broad market appeal and which have been found to have highly motivated management.

#### **KTEC agencies not evaluated**

The following KTEC agencies were either recently established or still under development at the time that projects were being surveyed for this report. It was felt that these agencies had not yet completed enough projects to support a meaningful evaluation of their effectiveness.<sup>1</sup>

#### *Commercialization Centers*

These agencies address business needs during the gap between completion of R&D and seeking seed capital to start up production and marketing:

- KIC (Kansas Innovation Corporation), Lawrence

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<sup>1</sup> Another agency previously associated with KTEC is KVAC, the Kansas Value-Added Center, which was associated with Kansas State University. This center was intended to enhance agricultural, economic, and rural revitalization by promoting the growth of value-added processing facilities. This program has now been transferred to Kansas Department of Commerce and Housing and has been reorganized. KVAC is not evaluated in this report.

- MACC (Mid-America Commercialization Corporation), Manhattan
- WTC (Wichita Technology Corporation), Wichita.

#### *Industrial Liaison Offices*

These agencies help existing companies identify and solve production and other technical problems, improve production processes, and capitalize on advanced techniques:

- TIC (Tech-Industry Consultants, Inc.), Lenexa.
- WKTC (Western Kansas Technology Corporation), Great Bend.

#### *Other programs*

- MLC (Manufacturing Learning Center), Manhattan, allows small- and medium-sized manufacturing companies to utilize the latest design and prototyping machinery and technologies for developing both products and processes.
- ITEC (Innovative Technology Enterprise Corporation), provides assistance to inventors and entrepreneurs in the commercialization, marketing, and development of new ideas. (This program has recently been absorbed into KTEC's Innovation Research Program.)

### **The KTEC budget**

Since fiscal year 1989, KTEC's main funding has been from the Economic Development Initiatives Fund, which consists of revenues from the Lottery and Racing Commissions. Since 1991 KTEC has received no general fund monies—those monies generally considered to be tax revenues.<sup>2</sup> MAMTC has received additional money from federal sources and from charges to clients. The Centers of Excellence have received additional funding from federal and private grants, and from charges to clients and royalties. Ad Astra has received additional funding from private investors. Investors in Ad Astra received a 25% state income tax credit; this “tax expenditure” is shown as a state contribution and subtracted from other sources in the discussion that follows.

Total sources of income for the years and agencies under review are summarized in Table 1.1. This summary is based on data of various types provided by the various agencies from accounts that

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<sup>2</sup> During FY1987-1991, KTEC received some general fund monies because lottery funding had not stabilized. During FY1989-1991 KTEC received approximately \$1.506M in general fund monies, constituting a little over 1% of the funds evaluated in this report.

were sometimes incomplete, had a variety of purposes, and used a variety of accounting conventions. Therefore, a significant amount of analysis and interpretation was required.

KTEC and the agencies under consideration received about \$107M in funding during FY1989-1994. Of this, about \$4M was carried over from earlier years, leaving about \$103M in new funding, or an average of about \$17M per year. About half of this funding came from the state of Kansas; the rest was leveraged from federal sources (about 33%) or from private sources (about 17%). The largest agency was HBC, which was also the most successful at leveraging outside funds. The two largest programs, HBC and NIAR, together account for almost half of all funding received by the agencies being evaluated.

**Table 1.1**  
**KTEC Funding, FY1989-1994**

Agency	Total	State sources	Federal sources	Other sources	Carry-over from earlier years	State share of total budget less carry-overs
AD ASTRA	\$4,711,456	\$3,577,370	\$0	\$1,134,086	\$0	0.759
AMI	\$10,531,956	\$6,312,369	\$2,492,466	\$1,637,089	\$90,032	0.605
ARMF	\$431,277	\$431,277	\$0	\$0	\$0	1.000
CDDP	\$5,674,750	\$3,395,537	\$586,440	\$798,261	\$894,512	0.710
CECASE	\$6,313,105	\$2,330,509	\$1,234,787	\$2,498,272	\$249,537	0.384
HBC	\$29,008,591	\$8,808,146	\$10,018,684	\$8,633,768	\$1,547,993	0.321
KTEC operations	\$13,027,566	\$13,027,566	\$0	\$0	\$0	1.000
MAMTC	\$13,738,185	\$3,696,928	\$10,041,257	\$0	\$0	0.269
NIAR	\$24,009,693	\$9,698,464	\$9,410,301	\$3,198,999	\$1,701,929	0.435
Total	\$107,446,578	\$51,278,166	\$33,783,935	\$17,900,475	\$4,484,002	0.498
Share of total budget less carry-overs	1.044	0.498	0.328	0.174	0.044	

Source: estimated by IPPBR based on data from surveys of agencies, adjusted to avoid double counting. For additional notes, see text.

### Major features of the ROPI evaluation approach

The following paragraphs summarize some major features of the ROPI approach as used in both this study and the previous study. Chapters 2 through 5 give a more extended description of some of the more important aspects of the ROPI approach as well as citations to more technical documentation.

### *Multiple indicators of success are presented*

This report includes data on indicators that measure fourteen different types of outcomes. Some outcomes, such as jobs and income, are widely used in evaluations of economic development programs. Other outcomes, such as patents and manufacturing startups, are less commonly used. We also provide a weighted indicator based on all 14 indicators. The indicators are described in Chapter 3.

Separate outcome data are provided for each of the several different KTEC agencies being evaluated. For each outcome, data are given on past outcomes actually realized. Data are also available on additional outcomes anticipated in the future, but these are not described in this report.

### *Present values are used throughout*

Because the benefit and cost measures are comprehensive, they include contributions that accrue at different points in time. To make these contributions comparable to each other, both benefits and costs are expressed in terms of the present value of the flow of contributions. The interest rate used in calculating these present values is referred to as the “social discount rate.” In this study we used a social discount rate of 12%.<sup>3</sup>

### *Multiplier effects are included*

ROPI is defined to include *all* effects of KTEC activities, including indirect or multiplier effects. The multiplier models used in this report are described in Chapter 5.

### *Benefit-cost ratios are emphasized*

For each indicator, the criterion of success is expressed as a ratio of gross benefits (improvements caused by KTEC) to costs (the improvements that might have happened if KTEC funds had been spent elsewhere). This benefit-cost ratio or BCR is a criterion that is widely used in benefit-cost analysis because it facilitates a fair comparison across different programs. BCRs are explained in more detail in Chapter 2.

In addition, for each indicator we calculate a “cost-effectiveness ratio,” defined as *net* benefits (i.e., gross benefits less costs) achieved per dollar of funding from Kansas government sources. This ratio leads to the same rankings among agencies as does the BCR. The cost-effectiveness ratio may be somewhat easier than a BCR for policy-makers to understand. A disadvantage of the cost-

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<sup>3</sup> The value of 12% was suggested by a Blue Ribbon panel of citizens; see Burress and Oslund [1994] for a full description of the panel and the methodology.

effectiveness ratio is that it changes with inflation or with the cost of living, making it hard to draw comparisons across different studies.

#### *A traditional benefit-cost analysis is included*

The ROPI approach is a generalization of traditional benefit-cost methods. One of the ROPI indicators uses the traditional approach, but the other indicators provide information not available in a traditional benefit-cost analysis. Differences between the two methods are explained more fully in Chapter 2.

### **Major features of the present study**

This study retained the most of the general structure developed in the 1994 study. The current study focused on making improvements in the data, parameters, and software used to evaluate KTEC, and in moving towards a system that KTEC can run independently. Major efforts were devoted to the following products:

#### *New versions of the multiplier models*

All of the multipliers were re-estimated using updated information.

#### *New questionnaires for firms*

The questions were revised in order to capture better information on the time-pattern of employment, sales, and investment resulting from KTEC-assisted projects. The main modeling software was modified to accept data from the revised questionnaires.

#### *New surveys of firms*

Old client firms were resurveyed with the new questionnaires, and new clients were surveyed for the first time.

#### *New software development*

A new software system was developed which captures information from the Centers of Excellence on their clients, then creates mailings and controls data entry of returned surveys.

#### *Systems to evaluate additional KTEC programs*

The evaluation system was extended so as to handle the special features of two agencies not previously evaluated: MAMTC and Ad Astra.



*System to allow KTEC to conduct surveys and run the ROPI analysis*

System were designed, and partly implemented, that will eventually allow KTEC to perform the ROPI analysis in-house. The purpose of this system is to reduce KTEC's cost for each ROPI analysis.

*Analysis of "attribution" using Unemployment Compensation Insurance data*

As in any evaluation, a critical issue is "attribution"—i.e., deciding whether KTEC can take full credit for actually causing all of the outcomes it is associated with. For this report, an independent study of attribution was made using Unemployment Compensation Insurance data which show employment and payroll all firms in Kansas during 1987-1995. This study was intended to supplement, but not replace, the main analysis based on surveys of client firms. It is contained in Chapter 7.

**Changes in exposition**

While this study has substantially the same structure as its predecessor, there are several changes in the format and presentation of results that should be noted.

*ROPIs are defined as benefit-cost ratios*

In this report, "ROPI" refers to a benefit-cost ratio (or BCR). This is slightly changed from the previous report. In Burress and Oslund [1994], ROPI was measured as the benefit-cost ratio, less 1. The purpose of the change was to simplify the explanation and make ROPI studies easier to compare with other evaluation studies.

*The traditional cost-benefit analysis is highlighted*

In this report we have singled out certain ROPI results that constitute a traditional benefit-cost analysis. (These results correspond to the "income" indicator.)

*Realized outcomes and anticipated outcomes are distinguished*

ROPI results are now broken out into two types. The first consists of ROPIs based purely on outcomes that were actually realized in past years. The second consists of ROPIs which include outcomes that are anticipated in the future by the firms that were surveyed. Only the realized outcomes are discussed in this report, because the anticipated outcomes are partly speculative.

### *The upper bound measures are dropped*

In the previous study, we included an upper error bound on anticipated ROPI, calculated by assuming that firms that failed to respond to the survey had outcomes that were similar to firms that did respond. We have dropped that upper bound measure from the present report. We believe that a lower bound measure, which omits non-respondents, is a better indicator of ROPI than the upper bound measure.

### *The “Kansas Growth” comparison is dropped*

In the previous study, we compared KTEC’s measured ROPI values with an artificial standard which we called the “Kansas growth model.” The Kansas growth model calculated a ROPI based on the assumption that *all* the growth in Kansas is caused by *all* the state government expenditure in Kansas. We found that the ROPIs calculated in this way were vastly smaller than KTEC’s ROPIs. In other words, a directed economic development activity such as KTEC is vastly more effective than mere “government business as usual,” at least from the point of view of economic development. That conclusion still stands. We do not present the corresponding results here because they would be qualitatively little different from those in the earlier report.

### **Outline of the report**

Chapters 2, 3, and 5 explain some of the methodology used in this report. Some readers may wish to skip these chapters on a first reading. The main results of this study are contained in Chapters 4, 6, 7, and 8.

Chapter 2 explains the overall ROPI concept, contrasts it with a traditional benefit-cost approach, and explains why we use multiple indicators of success. It describes the concept of a benefit-cost ratio in more detail. It explains why the ROPI values for a project are typically much larger than the corresponding rates of return on the same project, and it clarifies the idea of a “cost.”

Chapter 3 explains the meanings of the various indicators of success used in this study.

Chapter 4 describes the surveys of firms, and summarizes the direct results of the surveys.

Chapter 5 describes the economic models of Kansas which are used to derive various multipliers used in this study.

Chapter 6 provides ROPI values calculated from those results together with other data.

Chapter 7 contains a stand-alone study of “attribution” (i.e. KTEC’s share of responsibility for causing observed outcomes) using Kansas Unemployment Compensation Insurance data.

Chapter 8 compares results of this study with results from other studies.

Chapter 9 provides conclusions and recommendations.

## 2. THE ROPI APPROACH AND BENEFIT-COST RATIOS

This chapter explains some major features of the ROPI approach. It explains why there are multiple indicators, what measurement is meant by “ROPI,” and how ROPI compares with a more traditional benefit-cost approach. As we noted above, each ROPI measurement is a ratio of the benefits to the costs resulting from a public investment. This kind of measurement may be unfamiliar to many readers of this report. A benefit-cost ratio is conceptually quite different from (and typically much higher than) an ordinary rate of return on investment (or ROI). Therefore, this chapter also explains what a benefit-cost ratio is, explains how and why we use them rather than some other measurement, and explains how they compare with an ordinary ROI.

### **Multiple indicators of successful outcomes are included**

This report includes multiple indicators of success because KTEC has multiple goals, and because there are multiple ways to judge each goal.

#### *KTEC has multiple goals*

KTEC has several specific goals set out by legislation. These explicit, legislated goals focus on KTEC’s particular economic development strategy of transferring new technology to Kansas firms, and especially transferring technology to firms that help bring new dollars into the state by selling products and services out-of-state. In addition, KTEC also has implicit general goals it shares with other economic development agencies. These general goals include the creation of jobs and income and tax revenues in Kansas.

In contrast, most businesses have a unified, single goal of making profits. KTEC has multiple goals because KTEC is an economic development activity instituted by a democratic government. As such, its constituency includes many different interest groups. Each interest group focuses on a different goal or mix of goals. Thus, unemployed people might tend to focus on the creation of jobs; employed people might tend to focus on improvements in the quality of jobs; business people might tend to focus on increases in income or work force quality. Therefore, KTEC, like any economic development program, is examined against a variety of standards by individuals who have a variety of viewpoints.

Traditional benefit-cost analysis focuses on one single indicator of success, namely real income (often generalized to account for non-income effects on human well-being). This approach ignores many of the actual goals of policy-makers. Consequently, nearly every study of economic development uses, as a second indicator of success, the quantity of jobs created. Many studies use a third indicator, namely the new taxes collected as a result of economic development. Our study takes this natural development further and provides 14 different indicators of success. However, unlike other studies, we apply a rigorous benefit-cost methodology to each indicator. Our additional

indicators measure characteristics such as new patent registrations and manufacturing business startups. Each indicator measures a different outcome, reflecting a different aspect of KTEC activities, often related to different goals. The various indicators are described more fully in Chapter 3.

*It is sometimes useful to have multiple indicators for a single goal*

A second reason for using multiple indicators has to do with an intrinsic separation between abstract goals and concrete economic measurements. No single indicator that can be measured would perfectly reflect the underlying goal it stands for—there is always some degree of arbitrariness or incompleteness in measurements. Thus, given the goal of improving the average standard of living in Kansas, money income is a useful but imperfect indicator. “Standard of living” includes many qualities of individual experience that do not correlate very well with income—for example, health and leisure time and protection from crime. The use of multiple indicators for a single goal is one way to alleviate (but not completely solve) this problem, by singling out different specific aspects or attributes of the general goal.<sup>4</sup>

*Decision-makers may use either multiple or singular criteria*

Multiple indicators are an acceptable basis for some policy-making purposes, but they raise problems for other purposes. As an example of the former purpose, multiple members of a legislative panel might vote on an economic development budget, with each panel member focusing on a different (singular) indicator of success. In this case each panel member has sufficient information to determine his or her vote. As an example of the latter type, administrators of individual agencies might be given budgetary incentives that were based on several competitive indicators of success. The incentives in this case are ill-defined unless some definite weighting or value is assigned to each indicator of success.

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<sup>4</sup> Of course, another way to handle this problem is to try to refine a single indicator so it can reflect the goal more accurately. Thus, it is possible to improve the money income indicator, for example, by correcting for the cost of living and adding some estimates of the value of health improvements and leisure time. This approach is valid, but it is equivalent to forming multiple indicators and then weighting them in proportion to their importance to the underlying goal. Thus, in a “traditional” benefit-cost study, an indicator for leisure time would be added to an indicator of money income in proportion to an average relative tradeoff that individuals prefer between money and leisure time.

However, a single-indicator approach would foreclose more general approaches to weighting across indicators. For example, policy-makers might want to down-grade the importance of a leisure time indicator if it was less accurately measured than the money income indicator. Or policy-makers might make a political judgment that the trade-off rate for leisure time should be based on the preferences of a disadvantaged group rather than average preferences for all persons. More generally, policy-makers might want to have an indicator that corresponds to multiple goals, with varying weights for each goal. These modifications are practical to do in the ROPI framework, but not in the single-indicator framework.

In this report we provide a weighted indicator which could be used in situations requiring a unitary indicator of success. This weighted indicator is described more fully in Chapter 3.

### **Dimensions of the ROPI criterion**

ROPI or “Return On Public Investment” is measured by a ratio of benefits to costs. KTEC’s “benefits” are defined as improvements in the chosen indicator of success that were caused by KTEC. KTEC’s “costs” refer to whatever was lost or given up when budget dollars were given to KTEC rather than put to some other use. Costs are measured in the same units as benefits, and they represent the improvements in the chosen indicator that would have happened if KTEC’s dollars had been spent elsewhere. Both benefits and costs can vary along several dimensions.

#### *ROPIs differ by indicator*

Since benefits and costs refer to a particular indicator, there is a different ROPI or BCR for each indicator. That is, there is an income-ROPI, a jobs-ROPI, a patents-ROPI, and so on, with one for each indicator, including the weighted indicator. The income-ROPI, for example, is the ratio of new income generated by KTEC, to the income that would have been created by an alternative program. In this study, we assume that the alternative would consist in handing KTEC’s budget dollars to the taxpayers (including multiplier effects).

#### *ROPIs differ by KTEC agency*

This report also provides evaluations of several different KTEC programs. Individual ROPI values are provided for each agency that was evaluated.

#### *ROPIs differ by degree of realization*

There is an important difference between two kinds of benefits: those that were actually realized in the past, versus those that are still anticipated in the future. Measurements of anticipated future benefits are not really comparable with measurements of realized benefits because there are great differences in reliability of the measurements. For example, future benefits can be known to some extent when a firm forecasts its future sales from a successful innovation, but this measurement is much less reliable than the firm’s data on actual sales realized in the past. And yet, future benefits may need to be given some consideration in a fair comparison between programs. This is especially true in the case of new programs, where past investments simply have not had enough time to bear fruit. This report focuses on a “Realized ROPI” that excludes future benefits. Future benefits will be discussed only in qualitative terms.

## ROPI versus a “traditional” benefit-cost analysis

The ROPI method of benefit-cost analysis is quite traditional in many respects (e.g., use of economic models and measurements, use of benefit-cost ratios, use of discounting to make comparisons across time). In other respects it differs from a more traditional benefit-cost analysis. These differences have to do partly with the concrete mechanics of what and how different things are measured, and partly with the abstract story that rationalizes the measurements.

### *There are differences in procedure*

As we noted, a traditional benefit-cost analysis of government projects is based on a single indicator of success. This measure might be described as “generalized real income” or “aggregate standard of living” or “aggregate well-being.”<sup>5</sup> The measure consists of ordinary income, corrected for any changes in prices that occur as a result of the project, and then sometimes augmented with terms that represent the equivalent monetary value that individuals would place on various goods that can’t be purchased in ordinary markets. These non-marketed values might include such items as the value of government services received, the value of health and a clean environment, or the value of driving on roads that are not congested.

Traditional benefit-cost studies (and this study as well) use a “discount rate” to adjust benefits and costs occurring at different points in time. In traditional studies the discount rate is generally based on market rates of interest, corrected for inflation rates and for various possible “distortions” in the market rates. In this study, most results are based on a discount rate selected by a panel of citizens.

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<sup>5</sup> Some studies refer to it simply as “welfare”, but that term reveals little because it has a more general meaning. Professionals writing on benefit-cost analysis are often surprisingly skittish about defining precisely what indicator of welfare they have in mind, or else evasive about what name to place on it. Many authors use the general term welfare without defining it in terms of a specific indicator. Many authors also focus on approximated *changes* in welfare, rather than welfare itself. Approximated changes in welfare are described with names such as “consumers surplus” and “excess burden”, without specifying what exact indicator of welfare the authors intend to approximate. This evasiveness is closely related to the adoption of partial equilibrium framework (it is not possible to be conceptually vague in a well-specified general equilibrium model). Authors using an explicit general equilibrium framework use terms such as “money metric” or “equivalent income” which have precise meanings; however the latter term is also used in partial equilibrium approaches. Moreover, different authors differ greatly in their methods of including non-marketed goods in the welfare indicator; and these differences in some cases reflect unvoiced conceptual differences about what the welfare indicator actually signifies. At the same time, we emphasize that all of the traditional benefit-cost authors are in substantial general agreement on the basic thrust of the approach, which we have tried to describe informally above. A more extended review of some of these foundational issues is provided in Burrell and Rich [1997].

One indicator used in the ROPI approach corresponds to the traditional indicator, namely the “income” indicator. Therefore, this study includes a traditional benefit-cost analysis as a special case.<sup>6</sup>

But, as we noted, ROPI uses a number of additional indicators. Many of these indicators correspond to concepts that might arguably be included in a very broad indicator of standard of living. The weighted ROPI takes all of these indicators into account. Therefore, it might be viewed simply as a very broad benefit-cost analysis. However, the ROPI method for weighting the additional indicators differs from traditional methods.

*There are differences in philosophy*

These and other differences between ROPI and traditional benefit-cost analysis stem from differences in the philosophic underpinnings that motivate the method. The traditional approach posits the general value judgment that individual behavior in a perfectly competitive and efficient market place should be the *only* source for inferring specific value judgments in a normative economic analysis. (In cases where the free market fails to produce an efficient outcome, then the standard is what “would have” occurred if the market failure had somehow been corrected.) Since market outcomes are sensitive to the initial distribution of wealth, the traditional approach assumes that the existing distribution of wealth is already ideal.<sup>7</sup> Moreover, the traditional approach assumes that all individual goals should be summarized using a unitary aggregate of real income.

The ROPI approach in general assumes, in contrast, that there should be much more opportunity for policy-makers to inject value judgments into a normative economic analysis. This reflects the reality that democratic politics is concerned with many different goals, and that these goals can’t usually be summarized by aggregate real income. Moreover, benefit-cost methods are quite capable of providing useful information related to a large number of goals, and not merely aggregate income.

Political value judgments come into the ROPI model in three main ways: the choice of what indicators to focus on; the choice of relative weights used in the weighted indicator; and the choice of a discount rate. Like the traditional analysis, ROPI makes substantial use of economic models based on free markets; but the ROPI method treats these models as constraints on government policy, and as sources of subsidiary value judgments, rather than as sources of ultimate value judgments. In particular, maximizing aggregate real income could be a goal of government, but that is for policy-makers to decide.

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<sup>6</sup> The income concept used in this report is not an especially broad one, however. Also, the main discount rate used in this study is numerically somewhat larger than a real market rate plus a risk premium.

<sup>7</sup> Because most benefit-cost analysts do not actually believe that the existing distribution of income is ideal, there is a substantial body of benefit-cost literature that seeks to discover special cases where the benefit-cost outcome is independent of the given distribution of income. The authors of this report doubt that these special cases have much real-world applicability.



The main source for the value judgments used in this particular report was a Blue Ribbon panel of citizens, as described in the previous report [Burruss and Oslund, 1994]. While it is certainly possible to second guess the indicators and weights chosen by the members of the panel, all of the chosen indicators are interesting in their own right, and the weights chosen for the indicators provide one plausible way to aggregate the indicators. A reader will find this report most useful if he or she focuses on the particular indicators that seem important, rather than on the method by which the indicators and weights were selected.<sup>8</sup>

### **Some features of the benefit-cost ratios**

Many different ROPI measurements are given in Chapter 6 of this report. They are numerous because they look at many different aspects of KTEC. But all of the ROPIs are benefit-cost ratios, and all have several features in common. These common features include the following:

*A BCR should have completely comparable numerator and denominator*

A valid benefit-cost ratio (BCR) is a truly dimensionless quantity, i.e., a pure ratio which does not depend on any units of measure. Although it refers to some definite period of time, the ratio does not depend on whether you use years versus hours to measure time. Although it refers to measured outcomes, the ratio does not depend on whether you use dollars versus millions of dollars (or jobs or millions of jobs) to measure benefits and costs. The ratio is dimensionless because units of measurement are the same in the benefit numerator and in the cost denominator. Since the units are the same above and below, they cancel out.

More generally, a BCR makes little sense unless benefits and costs are conceptualized and measured in the same way in all respects (or at least, as far as possible). The only difference between them is that costs include whatever good things are sacrificed or given up, and benefits include whatever good things are received in consequence. (Note, however, that costs are always hypothetical, since they refer to things we *didn't* get; but benefits—or, at least, retrospectively+measured benefits—are real, because they refer to things that we *did* get.) If the numerator is defined in terms of jobs, then so is the denominator. If the numerator uses economic impact multipliers, then the denominator should use the same multipliers. If the numerator refers to benefits that follow from a particular government decision, then the denominator should refer to the costs that follow from that same decision.

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<sup>8</sup> At the same time, the authors of this report believe that future ROPI reports could be made significantly more valuable if a joint legislative committee, or the legislature itself, formalized a method for selecting indicators and weights.

### *A BCR should be based on comprehensive measurements*

In this study both the benefits and costs are measured comprehensively, so far as possible. In particular, they include not only the obvious direct effects of KTEC activities, but also the indirect or multiplier effects. For example, if KTEC helps a new firm get started, then the direct benefits include the new jobs and income created by that firm. The indirect benefits include the new jobs and income created in firms that supply that firm, and also in firms that serve the consumption needs of the jobholders (and successive rounds of secondary effects *ad infinitum*).

Also, the measurement includes benefits and costs that flow through several different channels. Benefits can result not only from activities of the firms that are helped, but also from direct activities of KTEC agencies in hiring employees and purchasing services. Also, benefits flow from multiple sources of funding, which include not merely the KTEC direct appropriation but also funds leveraged from federal sources and from private investment sources. Similarly, costs are defined to include the multiplier effects as well as the direct benefits that were forgone by using the budget dollars on KTEC rather than elsewhere.

### *Costs are defined as “opportunity costs”*

The idea of “cost” used in any benefit-cost analysis is that of *opportunity cost*, which refers to an evaluation of the alternative that was given up in order to perform the activity being evaluated. In our economic model, we assume that the alternative to KTEC activities would have been to give the dollars of the KTEC budget back to the households of Kansas by means of reductions in taxes.<sup>9</sup> (We assume that any legislative appropriations given directly to Universities for the Centers of Excellence would also have been returned to Kansas households.) The “value” of this alternative consists in the jobs and income and other indicators that would have been created by the inflow of new dollars, both created directly and also created through multiplier effects.

### **Why are the measured benefit-cost ratios so large?**

A BCR is conceptually somewhat similar to a rate of return, such as a measured Return On Investment (ROI). Either measurement can be viewed as a kind of ratio, in which the denominator refers to the cost of an investment, and the numerator refers to benefits resulting from the same investment. But BCRs are typically much larger than ROIs for the same project. Why do the measured values end up so different? There are many reasons.

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<sup>9</sup> In other words, we have chosen a “no program” counterfactual. Technically, to say that having no program is “second best” to having KTEC, would be to say that no other economic development program is sufficiently effective to warrant expansion. We do not actually believe that to be the case; we are merely choosing the simplest available standard of comparison.

### *BCRs include return of initial investment*

First, the BCR includes return of the initial investment (if it occurs), while the ROI does not. For example, if \$100 is invested for 1 year at an ROI of 5%, and then cashed out, the BCR is around 1.05 (i.e., 105%).<sup>10</sup>

### *BCRs aggregate over a relatively long period of time*

The numerator in the benefit-cost ratio adds up all benefits received across *many* years, while the numerator in an ROI refers to the return in a *single* (average) year.

Here is a simple example. Suppose that an initial investment of \$100 returns \$5 per year forever afterwards, and the principal is never returned. It can easily be shown that the ROI is 5%. However the calculated benefit-cost ratio is about 1, or 100%, which is 20 times as large.<sup>11</sup>

### *ROPI includes wages as well as property income*

In the particular case of ROPI, there are several additional reasons why the benefit-cost ratios are much larger than the range of ROI's we are accustomed to reading about. These reasons have to do with the type of benefits and costs being examined. Since we are dealing with returns to the Kansas public (wages, jobs, etc.), not returns to a private investor (profits), we have to focus on a very different notion of what is the cost of an investment and what is a return.

One reason in particular is that returns to *public* investment are defined to include wages and salaries and other benefits received by workers. These returns are completely ignored in calculating an ordinary ROI for a *private* investment. ROI looks at outcomes from the narrow perspective of the business owner and ignores any benefits to workers.

Table 2.1 contains data from a case study based on survey data collected for this report from one project for one firm.<sup>12</sup> ROIs are calculated, and also private and public benefit-cost ratios. As a simplification, we assume that finance capital as well as all purchased materials and supplies came

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<sup>10</sup> More precisely, the BCR in this case equals  $(1.05)/(1+\rho)$ , where  $\rho$  is the chosen discount rate.

<sup>11</sup> For calculating the present values of benefits and costs, this benefit-cost ratio used a discount rate just equal to the ROI, or 5%. By definition, however, the discount rate is determined outside the particular investment, and generally would *not* equal the calculated ROI. If the discount rate is less (or greater) than the ROI, then in this example the benefit-cost ratio corresponding to the ROI will be greater (or less) than 100%.

<sup>12</sup> The data have been changed by an arbitrary constant factor so as to conceal the firm's identity. The data include some anticipated returns as well as realized returns. The data have also been augmented with imputations from published sources; these augmented data estimate some firm-level detail that isn't needed in the aggregate ROPI model.

from out of state, profits are net of interest, and all profits are received in-state. Then we can calculate:

- Private cash flow = profits less investments
- The private ROI = (calculation based on the private cash flow using a standard method)
- The private BCR = (the present value of profits) / (the present value of private investments) = (the present value of the cash flow) / (the present value of private investments) + 1.
- Public cash flow = profits plus payroll less KTEC investments
- The public "ROI" = (calculation based on the public cash flow using a standard method)
- ROPI = the public BCR = (the present value of profits and payroll) / (the present value of KTEC investments) = (the present value of the public cash flow) / (the present value of KTEC investments) + 1.

The calculated public ROPI is much larger than the private benefit-cost ratio, most importantly because of the inclusion of wage and salary data in ROPI. (The stated ROIs and BCRs would probably get significantly larger if additional future years were included, since the investment did seem to be paying off rather well by the end of the reported time period.)

*ROPI includes leveraged federal grants and private investment*

The leveraging of federal dollars by KTEC agencies dramatically increases the measured ROPI because it increases the numerator but not the denominator of the benefit-cost ratio. KTEC activities do in fact bring in a substantial amount of dollars in federal grants and contracts. Table 1.1 shows that leveraged federal funds are a substantial source of the dollars expended by KTEC.

Attracting outside investment into the state also increases ROPI. We disallow costs to out-of-state investment sources in the denominator, because they are not paid by *Kansans*; but we do include benefits to Kansas workers and taxpayers in the numerator. Table 1.1 shows that leveraged private funds are also important to KTEC.

The two sources together generate about one dollar of leveraged funds per dollar of state expenditures on KTEC. About two thirds of the leveraged funds are federal; the rest are from private sources, both within Kansas and outside the state.

**Table 2.1**  
**Case Study of Private Versus Public Returns**

year	(1) private capital investments	(2) profit	(3) private cash flow (2)-(1)	(4) payroll	(5) KTEC investments (public cost)	(6) public cash flow (2)+(4)-(5)
0	\$10,500	\$0	(\$10,500)	\$0	\$0	\$0
1	\$42,000	(\$18,900)	(\$60,900)	\$52,500	\$252,000	(\$218,400)
2	\$52,500	(\$21,000)	(\$73,500)	\$105,000	\$0	\$84,000
3	\$0	(\$42,000)	(\$42,000)	\$210,000	\$0	\$168,000
4	\$52,500	(\$94,500)	(\$147,000)	\$262,500	\$0	\$168,000
5	\$52,500	(\$63,000)	(\$115,500)	\$315,000	\$0	\$252,000
6	\$42,000	\$52,500	\$10,500	\$367,500	\$0	\$420,000
7	\$0	(\$31,500)	(\$31,500)	\$367,500	\$0	\$336,000
8	\$0	\$0	(\$0)	\$420,000	\$0	\$420,000
9	\$168,000	\$315,000	\$147,000	\$525,000	\$0	\$840,000
10	\$0	\$378,000	\$378,000	\$630,000	\$0	\$1,008,000
Sum	\$420,000	\$474,600	\$54,600	\$3,255,000	\$252,000	\$3,477,600
Present value in year 0:	\$234,868		(\$146,536)		\$225,000	\$1,403,169
(Assumed discount rate:)	12.0%		12.0%		12.0%	12.0%
ROI		Private ROI:	1.8%		Public ROI:	76.0%
BCR		Private BCR:	0.4		Public BCR (ROPI):	7.2

Source: IPPBR

*Some indicators don't respond to increases in Kansas income*

For some indicators KTEC has extremely small opportunity cost denominators because these indicators are not sensitive to increases in Kansas income. This can lead to exceptionally large ROPIs. In other words, in these cases giving dollars to households is an almost completely ineffectual way to increase the indicator, while giving dollars to KTEC can be very effective. Explaining how that happens will require some elaboration.

Consider the indicator for patents as an example. Most kinds of economic activity in Kansas have very little impact on patent activity. An increase in Kansas output in sectors such as agriculture or

printing or any of the household services has essentially no impact on Kansas patents, because these sectors typically do not generate patents in Kansas. In contrast, an increase in output in a manufacturing sector such as aircraft does tend to have positive effects on R&D, which can eventually lead to patents. But at the same time, the aircraft sector is not influenced much by changes in Kansas income—because an extremely high proportion of aircraft are sold to out-of-state customers. It follows that very little opportunity cost for patents comes out of the aircraft sector. In other words, if KTEC handed all of its budget over to the consumers of Kansas, there would be multiplier effects on many sectors of the Kansas economy, but hardly any of these effects would reach the aircraft industry.

The same is true for other manufacturing sectors: in general, the sectors that generate patents, are also sectors that sell nearly all of their product out of state (or they supply goods to sectors that sell out-of-state). Therefore, the number of new patents that can be expected, if we merely hand dollars over to Kansans and wait for multiplier effects, is minute.

Consequently, the opportunity cost is very small, in terms of patents forgone if we don't give dollars to households. At the same time KTEC does generate a significant number of new patents, so the measured benefit is relatively large. It follows that KTEC's ROPI in terms of patents is extremely large—a significant numerator is being divided by a very small denominator.

This result is not spurious; it is real. Giving dollars to KTEC is in fact vastly more productive of patents than giving dollars to households.

In contrast, handing dollars to Kansas households is a very good way of increasing Kansas income, because all of the dollars count as income, and in addition there are significant multiplier effects that would generate more income. So we should expect to find (and we do find) that KTEC's ROPI for income is much smaller than its ROPI for patents.

A point which needs to be emphasized is that BCR for patents means the number of patents obtained per *patents* forgone. It does *not* mean the number of patents obtained per *dollars* forgone, though that is also an important concept which has a different name (cost-effectiveness ratio).

It should also be clear from this example that the ROPI for patents is simply not comparable to the ROPI for income. Creating patents and creating income are different activities that can't be compared to each other—this is an “apples and oranges” problem. Policy-makers simply have to decide how much they care about total patents (and the technology it stands for) versus how much they care about income (and the consumption it stands for). They also make the same kind of relative weighing for other possible goals and indicators before they can evaluate economic development programs.

## **Large benefit-cost ratios have been found in other studies**

Previous studies of economic development programs have sometimes found large benefit-cost ratios, explicitly so in the case of income dollars, inferentially so in the case of jobs. On the other hand, there have been a number of economic development projects in other states (including some very large programs) that apparently had very low benefit-cost ratios. For examples of both types, see the discussion of other evaluation studies in Chapter 8.

For other indicators such as patents, our BCRs are the first that have been measured. But there is no reason to expect that our results are out of line.

## **Making interpretative sense of an unfamiliar measure**

What is a “good” or “bad” level for a given ROPI? Interpreting the significance of a given value of ROPI depends on the circumstances.

### *ROPIs can be used as measures of relative worth*

When making direct comparisons between measured benefit-cost ratios of different programs, the interpretation is straight forward. Agencies that have a higher ROPI on a given indicator have done a better job of producing that indicator than agencies that have a lower ROPI on that indicator. If one agency has twice the ROPI of a second program, then the first agency has done twice as well at producing outputs of that indicator.

Of course, as in any evaluation, such a conclusion would be only a starting point for additional analysis. We would still have to ask how accurately the ROPI has been measured, i.e., what is the error bound on each measurement. We would have to ask whether we expect the agency that did poorly to do better in the future. (Perhaps the less successful agency started more recently, and many of its projects have not had time to pan out. Perhaps the agency is shooting for a single, exceptionally large success, and hasn't yet got over the initial threshold. Perhaps the agency makes sense as part of a venture capital portfolio—in venture capital investments it is expected that some projects will fail while others will have very high returns.) We also have to ask whether the agency did relatively better with respect to other indicators. But the initial meaning of any BCR comparison is clear: higher is better.

For other kinds of uses, the meaning of ROPI will not become clear until other studies have been done. We do not know whether KTEC's ROPI is higher or lower than other Kansas economic development programs, because those other agencies have not been rigorously evaluated. And comparisons between KTEC's ROPI and evaluations of similar programs in other states will require some additional work to translate those studies into terms that are comparable to this study.

*ROPIs can be used as measures of absolute worth, but political judgment is needed*

For yet other kinds of uses, the interpretation of ROPI values raises questions of political judgment that have no obvious or simple answers. Would an income-ROPI of 4 or a job-ROPI of 5 be high enough to justify increased funding for economic development programs in general? Ultimately, the legislature will simply have to make a decision. That decision will be based on many different considerations, such as the perceived relative importance of increasing jobs and income versus the importance of other government goals such as reducing crime or reducing traffic congestion. Benefit-cost ratios can contribute to that decision by measuring the effectiveness of different programs in reaching their respective goals. However, at first legislators will not be accustomed to benefit-cost ratios at all and will find it hard to think about them. That is one reason why, in addition to BCRs, we have provided cost-effectiveness ratios in this report—they give legislators a more direct type of result, namely net KTEC outputs per budget dollar, to help them interpret the corresponding benefit-cost ratios.

At the same time, we want to emphasize that the main idea of a ROPI is quite understandable. It simply compares the amount of something KTEC actually creates, to the amount of the same stuff that would be created by handing the same dollars back to the taxpayers. Thus the income-ROPI is a ratio of the income generated by KTEC to the income that could be generated by handing dollars back to the taxpayers. If the ROPI for a given agency were 1 or less for every indicator that legislators care about, then the policy recommendation would be absolutely unambiguous: that agency should either be improved or closed down.

*Some ROPI comparisons are meaningless*

For other uses yet again, the intended comparison is simply meaningless. In particular, any attempt to compare ROPIs belonging to different indicators would encounter an apples-and-oranges problem. The high ROPI for patents can't be compared with the relatively lower ROPI for income; the two ROPIs simply don't measure the same kind of thing. It makes no sense to say that KTEC is "more" productive at creating patents than at creating jobs; it's like saying that an automobile is faster than it is fuel-efficient, or more comfortable than it is brightly-colored.<sup>13</sup>

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<sup>13</sup> This is related to the fact that the weighted ROPI cannot be a weighted average of other ROPIs. Instead, the weighted ROPI must be a ratio of weighted benefits for different indicators to weighted costs. The weights represent a political choice about the acceptable tradeoff between achieving different indicators (therefore the weighted indicator represents an aggregate goal, and weighted ROPI represents a rate of efficiency for achieving that goal). It would not make sense to have a political choice about acceptable tradeoffs between rates of productivity for different indicators—i.e., between different ROPIs—for two reasons. First, ROPIs cannot be chosen; they are simply observed historical facts about different techniques of economic development. Second, ROPIs are not political goals as such; they are rates of productivity for achieving political goals.



## **Why do we use benefit-cost ratios instead of rates of return or effectiveness ratios or net present values?**

There are many ways to measure the success of a public investment project. Given a measured stream of benefits and costs of an investment, it is technically possible to calculate a rate of return mathematically similar to an ROI. Such a rate of return is called an “internal rate of return.” In fact internal rates of return are sometimes used in cost-benefit studies. It is also possible to calculate the NPV (Net Present Value) of each investment. Another useful measure is a “cost-effectiveness ratio,” which shows the NPV for an indicator, divided by the budgetary dollars that were spent.

In this report we focus on benefit-cost ratios because, in the opinion of experts on benefit-cost analysis, they are the best single measure of investment success for programs like KTEC. We also calculate effectiveness ratios, which are easier to understand in some situations. We do not provide any internal rates of return; and we provide NPVs only in selected cases.

### *NPVs are best, but often can't be used*

In theory NPVs are the best way to measure investment success, if used carefully by a sophisticated user in conjunction with other information. An NPV measures the total achieved outcomes of the program. That is, an NPV gives the total value of the benefits received, less the total value of the cost paid out, corrected by discounting for the time of occurrence.

However, NPVs are rather hard to use for making policy decisions, because the NPV is an “extensive” measure rather than an “intensive” measure. In other words, its value depends on the *scale* of the investment project, as well as on the rate of productivity per unit input. When policy-makers compare a larger agency with a smaller program, they need some way to control for the size of the program. With NPVs, that would take a lot of additional effort. But benefit-cost ratios control for the agency size automatically. You can't say one agency is better than another just because it has a higher NPV (because it might have spent more dollars); but you *can* say it is better just because it has a higher benefit-cost ratio. That is why we provide benefit-cost ratios rather than NPVs.

### *ROIs are seriously misleading*

The reason we do not provide internal rates of return (which correspond to ROIs) is that they can be seriously misleading. They are not an accurate measure of success except under special conditions that do not generally apply to KTEC. There are two separate reasons for this.

First, there is a technical problem which can arise when investments and benefits both vary over time. If costs exceed benefits in some years and are exceeded in other years, then the equation which defines an internal rate of return can have multiple solutions. That usually makes any comparisons between agencies impossible.

Second, and more importantly, internal rates of return can and often do mis-rank the NPVs of projects. That is, one project can have a higher NPV than another project of equal size, and yet have a lower internal rate of return. Hence internal rates of return are not a valid indicator of the relative success of projects.<sup>14</sup>

*Cost-effectiveness ratios are helpful when the price level does not change*

Cost-effectiveness ratios directly measure the amount of bang for the buck, e.g., the amount of jobs or income generated per budget dollar. These ratios may be more immediately understandable to policy-makers than benefit-cost ratios. Moreover, for making comparisons that focus on a single period of time, they are just as good as benefit-cost ratios. That is why we provide cost-effectiveness ratios in this report.

However, policy-making often depends on comparisons that extend across time. Policy makers may want to compare a new agency to historic experience in related but older programs. Or they may want to ask whether a given agency has retained its effectiveness over time. Cost-effectiveness ratios are seriously flawed for these kinds of comparisons because they are not inflation-proof. The denominator of a cost-effectiveness ratio is measured in budget dollars, which have different real values in different years. Their real values may also differ across states in the same year.

Of course, one could make corrections for changes in the real value of the budgetary dollar. That would be rather inconvenient, however. The policy-maker typically can't make those corrections in his head. Also, the corrections would need to be made for each separate report that any policy-maker wants to compare. And the corrections would need to be updated year after year. Moreover, making the corrections appropriately does raise some modest technical difficulties (e.g., Kansas-specific price indices are somewhat inaccurate and hard to obtain; e.g., the "value of a Kansas budget dollar" is conceptually different from the "value of a Kansas consumption dollar"). Therefore, we will conduct our main discussion in terms of ROPIs, or benefit-cost ratios.

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<sup>14</sup> For full discussion of this problem, see a text on public finance or benefit-cost analysis; e.g., Boadway and Wildasin [1984, p. 192-193]. The basic problem is that internal rates of return ignore the discount rate. Because rates of discount measure the relative importance of benefits and costs occurring at different points in time, they should be included as an important input into any investment decision.

### 3. THE INDICATORS OF SUCCESS

The significance of a benefit-cost ratio obviously hinges on the significance of the underlying indicators being measured. In this section we discuss the various indicators used for the benefit-cost ratios of this report, including the weighted average of the other indicators.

#### **Selecting the indicators and weights**

The indicators and weights were chosen by a Blue Ribbon panel of citizens, or what is sometimes called a "policy jury." In 1993, during the previous ROPI study, extensive oral and written materials on economic development and on KTEC were presented to the panel. After an extensive discussion of the issues, the panel determined indicators and weights using a sophisticated voting procedure.<sup>15</sup>

The indicators are divided into five groups corresponding to five general goals. The indicators for a given goal were assigned equal weights.

#### **Benefits and costs count only if received by Kansans**

KTEC is an activity of the State of Kansas. The State of Kansas is intended to be a mutual benefit organization run by and for presently existing persons who reside and vote and pay taxes in the geographical region of Kansas. The activities of the State of Kansas are conducted mainly in the particular interests of those persons and not in the general interests of human beings in the world at large.

In this study, as in most other regional benefit-cost studies, we study the benefits and costs experienced by existing residents of the region in question, i.e., the effects on Kansans. We do not include external effects on citizens and taxpayers of the world at large. The point of the study is to tell Kansans what is in their interest, to help them formulate legislative policy. It is not a purpose of the study to tell citizens of the rest of the world what is in their interest, because in practice they do not have a voice in Kansas policy.

Economic development in general, and KTEC activities in particular, attract many new residents into the state. The benefits and costs experienced by these newcomers are not counted among the benefits and costs used in this study. The reason is that these new residents did not sacrifice the dollars, did not bear the costs, and did not participate in the decisions that underlay the KTEC activities that brought them into the state.

Suppose for example that KTEC were generating millions of dollars of income and thousands of jobs, but it was discovered that all of the benefit (including multiplier effects) went to newcomers who

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<sup>15</sup> The full methodology is described in Burress and Oslund [1994].

moved into the state solely to get the jobs, and none of it went to the taxpayers in whose name the legislature authorized KTEC. Then the legislature might reasonably prefer to put KTEC funds to work at other purposes.

The results given in later chapters indicate that this hypothetical situation is far from being the case. KTEC is in fact valuable to existing citizens of Kansas. We know this because we did subtract estimates of effects on newcomers from the measures of jobs and income and other indicators reported in this study.

### **14 indicators are used in this report**

This report uses 14 indicators grouped into 5 goals, plus a weighted indicator. The goals and indicators are described below.

#### *Goal 1: Kansas has a supportive business climate*

Indicator A. Manufacturing start-ups.

This indicator includes the number of new firms that came into existence in Kansas as a result of KTEC activities.

Indicator B. Five-year survivals of manufacturing firms

This indicator includes the number of new firms in Kansas that lasted for five years as a result of KTEC activities.

Indicator C. Federal funds for R&D

This indicator includes the dollars of federal grants and contracts for research and development leveraged into Kansas as a result of KTEC activities.

Indicator D. Non-federal funds for R&D

This indicator includes all private funds leveraged in research and development uses in Kansas as a result of KTEC activities.

Indicator E. Tax Revenues paid by firms

This indicator includes the new tax revenues from business-related state and local taxes that resulted from KTEC activities. These taxes include property taxes, income taxes on profits, and sales taxes on goods and services used by the business.

#### Indicator F. Patents issued

This indicator includes the number of new patents issued to Kansans (individuals and organizations in Kansas) as a result of KTEC activities.

#### Indicator G. Infrastructure investment

This indicator includes the new investments in private infrastructure supportive of new business that occurred as a result of KTEC activities. In particular, it includes investment in telecommunications and utilities.

#### *Goal 2: Kansas has a highly-skilled workforce*

#### Indicator H. Workforce training

This indicator includes the number of full-time-equivalent students that completed one year in technical or vocational training in Kansas as a result of KTEC activities.

#### Indicator I. Human capital stock

This indicator includes increases in the total years of experience and education of skilled workers in Kansas, as a result of KTEC activities. (Experience is adjusted relative to education and depreciated for elapsed time using Kansas specific data on the wages that result from experience and education.)

#### *Goal 3: Kansas creates and maintains middle-income and high-skilled jobs*

In the following indicators, each job is weighted by the number of years that the job was held.

#### Indicator J. Good jobs - income

This indicator includes increases in the number of workers holding jobs that pay good wages—defined as earnings equal to at least those earned by workers whose household income is in the 40th percentile of Kansas earnings—that resulted from KTEC activities.

#### Indicator K. Good jobs - occupational titles

This indicator includes increases in the number of workers holding jobs with professional, managerial, or technical job titles that resulted from KTEC activities.

#### Indicator L. Good jobs - education

This indicator includes increases in the number of workers holding jobs that require at least two years of post-secondary training that resulted from KTEC activities.

*Goal 4: Kansas creates and maintains jobs*

Indicator M. Total jobs

This indicator includes increases in the total number of jobs held by Kansans that resulted from KTEC activities.

*Goal 5: Kansas has high totals of income and wealth*

Indicator N. Personal income

This indicator includes increases in the total income received by Kansans that resulted from KTEC activities.

**The weighted indicator can be used to summarize all indicators**

Given multiple indicators of success, there may be varying or inconsistent implications making it hard to draw any definite conclusions. When the goal is to assign a specific ranking or grade to each KTEC program, then we will need some one way to focus on one single criterion of success. A weighted indicator is a way of summarizing the 14 original indicators into a single criterion.

For making comparisons between programs, readers of this report who believe the given weights are at least roughly reasonable will probably want to focus on the weighted indicator. Those weights do represent the average opinion of an informed group of citizens who spent some time thinking about what weights would be appropriate. Other readers may prefer to focus on selected indicators such as jobs or taxes. Readers who want to use a traditional benefit-cost approach should focus on the single indicator for income.<sup>16</sup>

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<sup>16</sup> It would also be easy to create a new weighted indicator using any desired combination of weights. However, we again emphasize that it would not be appropriate to use a simple weighted average of the different ROPIs reported below. Instead, one needs to take a weighted average of the benefits for the different indicators, and divide by a weighted average of the costs for the different indicators. In other words, in order to formulate a coherent or self-consistent decision-making procedure using the benefit-cost approach, we first need to decide on a definite aggregated political goal, which in this case is represented as a weighted average of the 14 goals; next we need to measure benefits and then costs in terms of that aggregated goal; and finally we need to calculate its benefit-cost ratio.

The weights used in this study for the different goals and indicators are given in Table 3.1. Each indicator for a given goal has the same weight. The weights of the indicators for each goal add up to the total weight for that goal.<sup>17</sup> The goal weights add up to one.

The weights represent a set of political value judgments about acceptable tradeoff rates between changes in different indicators, where the changes are normalized in proportion to statewide aggregates of those indicators. In other words, if weight X is twice as big as weight Y, then the average panel member believed that a 10% increase in indicator X is equally valuable to the state as a 20% increase in indicator Y.

### **Indicators are based on extensive data and economic models**

The measured values of the indicators depend on the data sources and economic models that are described in the next sections. All the different indicators use the same basic economic model to analyze multiplier effects; however, for each indicator there is an additional satellite model which relates the basic model to that indicator (using what is known as a “bridge multiplier”).

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<sup>17</sup> As a simplification, all indicator weights for a particular goal were assumed to be equal.

**Table 3.1**  
**Goals, Indicators, and Weights**

Goal 1: Kansas has a supportive business climate	
Indicator A. Manufacturing start-ups.	0.0349
Indicator B. Five-year survivals of manufacturing firms	0.0349
Indicator C. Federal funds for R&D	0.0349
Indicator D. Non-federal funds for R&D	0.0349
Indicator E. Tax Revenues paid by firms	0.0349
Indicator F. Patents issued	0.0349
Indicator G. Infrastructure investment	0.0349
Goal 2: Kansas has a highly skilled workforce	
Indicator H. Workforce training	0.1114
Indicator I. Human capital stock	0.1114
Goal 3: Kansas creates and maintains middle-income and high-skilled jobs	
Indicator J. Good jobs - income	0.0612
Indicator K. Good jobs - occupational titles	0.0612
Indicator L. Good jobs - education	0.0612
Goal 4: Kansas creates and maintains jobs	
Indicator M. Total jobs	0.1811
Goal 5: Kansas has high totals of income and wealth	
Indicator N. Personal income	0.1680



## 4. SURVEYS OF FIRMS

Client firms served by KTEC-supported agencies were surveyed to ascertain the effects of KTEC on business outcomes. This chapter describes the surveys.

### **Various survey forms and protocols were used**

The survey forms and data collection methods differed to some extent by program. These differences were related partly to differences in the purposes of the programs, and partly to practical differences in administrative procedures in the various agencies. However, the basic concepts were similar.

The survey forms gathered data on the nature of the project being served, the outcomes of the project (jobs, wages, sales, and investment), and the importance of KTEC intervention to success of the project. Major variants of the survey forms are included in the Appendix.

### **Response rates differed across programs**

Response rates for the various surveys are estimated in Table 4.1. The rates are relatively low for several of the programs, especially in the surveys of Centers of Excellence. Known causes of some non-responses include:

- defunct firms
- firms that moved out of state
- firms in which key project personnel had left.

Likely other causes of the low response rate for Centers of Excellence include these problems:

- the survey form was computer-generated and appeared longer than it actually was
- survey performed by KTEC personnel for first time rather than by a statistical laboratory.
- survey was not the top or sole priority of personnel
- many firms had been surveyed previously
- many firms in the sample had very small contact with the agency
- firms were not contractually required to respond.

**Table 4.1**  
**Survey Response Rates**

Program	survey date	response rate
Ad Astra	May-96	0.48
ARMF	Jun-96	0.29
MAMTC	Apr-95	0.72
Centers:		
AMI	Jan-95	0.37
CECASE	Jan-95	0.50
CDDP	Jan-95	0.38
Higuchi	Jan-95	0.16
NIAR	Jan-95	0.11
Source: IPPBR		

## 5. ECONOMIC MODELING

This chapter very briefly summarizes the economic models used in this study. More complete detail is given in our previous study [1994] and in various technical documentation.<sup>18</sup>

### **Multiple channels were analyzed and multiple models were used**

Activities of KTEC agencies can affect the Kansas economy through several different paths, or channels of influence. Each channel raises different problems in economic measurement and modeling.

#### *Four types of direct effects were measured*

We can classify direct actions on the Kansas economy stemming from KTEC into four main types:

1. Client firm operations: The client firms helped by KTEC may make changes in their economic activities, including payments for wages and salaries, income paid to owners, taxes paid to various government units, purchase of inputs to research and production, and sales of goods and services.
2. KTEC operations: KTEC agencies may make direct payments to KTEC employees and to providers of goods and services.
3. State budget cost: KTEC withdraws some dollars from the Kansas economy by means of the Kansas state budget.
4. Federal budget cost: KTEC accepts some leveraged funding from federal sources, which depend in turn partly on federal taxes in Kansas. However, this leads to such a very small cost to the Kansas economy that it can usually be ignored. In particular, we will assume that Kansas is competing with other states for a fixed pool of federal funds, so that successful grants applications by Kansas do not lead to any increases in federal taxes in Kansas.

These four activities constitute what is referred to as the “direct effects” of KTEC on the Kansas economy.

#### *Indirect effects were estimated using a variety of models*

In addition, all of these activities lead to “indirect effects” or multiplier effects, because payments or withdrawals generate second-round payments or withdrawals, which in turn generate additional

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<sup>18</sup> For a more complete description of the models, see Burrell and Oslund [1994]; IPPBR Economic Research Technical Notes (ERTNs), Numbers: 151-153, 158, 168, 169, 171-174, 176, and 178; IPPBR Economic Research Software Notes (ERSNs), Numbers: 38, 40, and 44-49. Other technical documentation referring to parts of the model developed in previous ROPI projects are cited therein. ERTN 178 is a guide to the documentation.

rounds of effects. In the ROPI model, these various different channels of influence are necessarily calculated in different ways with differing degrees of accuracy. Therefore, we sometimes need to examine these individual channels of influence separately.

#### **Direct effects by client firms were measured using survey data and published data**

Direct effects due to the activities of client firms were estimated using the surveys described in the previous chapter. However, any survey is limited in the amount of information it can gather. Therefore, the survey questions probed the activities of firms only in terms of relatively gross and general categories. But getting a careful estimate of multiplier effects depends on getting a detailed picture showing, for example, what narrow sectors of the economy supplied the firm with particular goods and services. To get from the gross picture to the detailed picture, we used ratios based on data taken from published sources; the data were specific to the types of firms we studied.

#### **Direct effects of agency activities were measured using administrative data**

Agency data were employed in three different ways in the ROPI model.

##### *Market-place activities*

The quantities of direct employment and purchases by KTEC agencies were estimated from detailed financial, budgetary, and operational data obtained from the various agencies. In general, however, the raw information was not organized according to categories and concepts needed for this impact study. In particular, records were not always organized according to comparable time periods or view points: some records were based on the original appropriations, some were organized by the time of receipt or source of funds, and some were organized by the time or type of expenditure. Also, it was not always possible to make the records of receipts balance the records of expenditures. In addition, expenditures were not broken out with type or degree of detail that is desirable for an impact study. In general, these problems were handled using reasonable assumptions, in some cases making use of published data on the expenditure profiles of comparable research and service organizations.

##### *Allocation of outcomes for clients with multiple patrons*

In cases where multiple agencies assisted a single client firm on a single project, steps were needed to avoid double counting of the impacts. For this study, the attribution or credit to each agency for any positive outcomes of the project was allocated between agencies on an equal basis per agency involved. (In general detailed information on the amount of services provided by each agency were not available.)

### *Agency databases on outcomes*

The agencies had independent data sets that tracked certain types of positive non-monetary outcomes of client firms, such as patents and new technologies. These data were used to supplement the surveys of firms.

### **Direct effects of funds withdrawn from the Kansas economy were estimated using data and models**

The opportunity cost of KTEC consists in the effects of all funds withdrawn from the Kansas economy for use by KTEC. These withdrawals have several potential sources, of which state government is the most important.

#### *Kansas state government funds*

In the current version of the ROPI model, the opportunity cost is assumed to consist purely of funds provided to KTEC by state government. Kansas state government funds for KTEC come from two sources: direct appropriations for KTEC, and appropriations for the Centers of Excellence in the University budgets. Both quantities are available in published budgetary data.

#### *Private investment funds*

All of the client firms served by KTEC agencies put up some investment funds from private sources. In the current ROPI model, no private investment costs at all are included in the opportunity cost. This is appropriate if, in the absence of the project that KTEC assisted, the investment funds would have mainly been placed out-of-state. There does exist some data implying that most Kansas saving is ultimately invested out-of-state, and also that most Kansas investment comes directly or indirectly from out-of-state sources.<sup>19</sup>

#### *Federal funds*

Expenditures from federal dollars create significant benefits in Kansas but not much corresponding cost. ROPI focuses on benefits and costs to *Kansans*; but some 99% of the cost of federal taxes is borne by non-Kansans. Therefore, federal expenditures are not included in the opportunity cost of KTEC.

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<sup>19</sup> However, we hope that this part of the ROPI model can be improved in the future based on additional research on the origin of private investments in Kansas.

## **Indirect effects were estimated using a Social Accounting Matrix (SAM) model and bridge models**

Indirect effects of KTEC activities are modeled in two stages. The first stage is a relatively conventional impact model, which estimates indirect effects on dollar values of output, income, and taxes. The second stage consists of bridge models, which estimate the changes in non-dollar indicators that correspond to the dollar-valued changes.

### *The impact model*

The first-stage model is called KSSAM version 2.2; it is a relatively conventional multiplier model based on a Kansas "social accounting matrix" (or SAM, meaning a table showing flows of dollars between all parts of the economy). This model analyses dollar flows in the Kansas economy into 48 business sectors, four household sectors (depending on sources of income), and four government sectors, plus exogenous imports and final demands, for a total of 57 sectors. For each sector, the model contains parameters showing how it affects every other sector. These parameters are boiled down from approximately 10,000 published data items. Using these parameters, this model can analyze the total effect in dollar terms on each sector that would result from dollars flowing into a given sector from outside Kansas.

### *The bridge models*

For each of the non-dollar indicators, a separate bridge model shows how that indicator is likely to be affected by economic activity in each sector. Each bridge model is based either on a regression study or on some other analysis showing how that indicator relates to economic activity in the various sectors. Depending on data availability, the studies are based on time series data for Kansas or the US, or on cross-section data for Kansas or across all states. (See Burress and Oslund [1994] for more details.)

## **Spillovers were omitted as channels of impact**

Economic development at a given location, and especially technology development, is heavily influenced by what already exists at that location. It is important for new development to have specialized suppliers, specialized service providers, specialized labor force, and specialized governmental activities already in place. But this creates a kind of chicken-and-egg problem: these inputs to technology cannot exist until they have down-stream technology firms to sell to. Moreover, each type of service unit has a minimum effective size; that is, the unit is not economically viable until it has a sufficient amount of business. (For example, a consulting firm usually needs to support at least one consultant full-time.) Moreover, as the concentration of related activity increases at a given location, suppliers can become more and more specialized, and hence more efficient and more effective. These and similar characteristics of technology are referred to as "economies of

agglomeration,” which can include more specific “economies of scale” or “economies of localization.”<sup>20</sup>

*Kansas has not experienced a recent “critical mass” event*

It follows from these facts that new development tends to be attracted to places where old development has already taken place. There tends to be a “critical mass” effect, or a “take-off” point: a sufficiently large accumulation of a given type of technology in a given place tends to create and sustain its own growth. An example of this phenomenon at work is the development of Lear Jet in Wichita, a location where a critical mass of aeronautical design and manufacturing capacity already existed. (Some other famous examples include California's Silicon Valley, Boston's Route 128, and the Research Triangle in North Carolina.)

If KTEC helped to develop some infant industry or new technology complex into this kind of critical mass, then KTEC could potentially have a triggering impact that far exceeds the direct and multiplier effects we have measured in the ROPI model. But no such “technology take-off” has happened recently in Kansas. If it does happen in the future, the emergence of the new technology complex will probably be quite apparent from articles in the business press; we won't need a ROPI model to identify it. Where an evaluation model such as ROPI could play a part is in tracing and evaluating KTEC's detailed role in the emergence of the new technology complex. Since this issue is not actually relevant now, but only potentially relevant in the future, the ROPI model used in this study did not address it.

*This report captures a portion of spillovers but does not measure them directly*

However, even short of the take-off point, there are several related channels of impact that might occur. First, development of one technology firm does tend to have a positive influence on other technology firms located nearby, even when firms are below the critical mass. That leads to spillovers between technology firms that result from the economies of agglomeration discussed above.

A second channel of impact between firms is simple imitation (sometimes referred to as “diffusion” of an innovation). Other firms may copy new ways of doing things, which improves their technology without incurring the same development expenses that were borne by the initiating firm.

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<sup>20</sup> Economies of agglomeration are reductions in cost that result when an increasing amount of economic activity is carried out at one place. Internal agglomeration economies such as economies of scope or economies of scale occur within a single firm. (However, these benefits might be passed on to the customers.) External agglomeration economies occur between firms and perhaps between firms and other agents; this includes localization economies and urbanization economies. Localization economies refers to cost reductions that occur when an entire group of related businesses share a location. Urbanization economies (and diseconomies!) occur when unrelated activities occur at a single location. See Blair [1991, Chapter 4] for more detail.

A third channel of impact consists in educational spillovers and other indirect effects of the Centers of Excellence. In other words, the Centers may create an economic climate which translates into technology-based enterprise and development. For example, the existence of graduate students and research activities in a University town may encourage start-up firms to locate in that town. The resulting opportunities and advantages for these firms might include: hiring graduate students as part-time employees; recruiting recent graduates as permanent full-time employees; hiring faculty members as consultants; and obtaining advanced technical training for ongoing personnel. Also, existence of these services might encourage increased technology activities in a firm already located in the town. All of these effects stem from the technical schools of the University in general, rather than from the Centers *per se*. However the Centers do tend both to increase the sheer mass of technical activity occurring at the Universities and also to redirect existing technical activity into more applied areas.

A fourth channel of impact is that KTEC activities may lead to improvements in quality and quantity of skills in the Kansas technical workforce. These improvements in turn may encourage technology firms to locate or develop in Kansas.

Like other evaluation models we have reviewed, the ROPI model used in this study did not *directly* measure these kinds of technology spin-offs and spill-overs. (We hope to study some of these issues in the future.) At the same time, our model did tend to capture much of this spin-off *indirectly*, for the following reason. Only actively-developing technology firms are in a position to benefit from technology spinoffs. But an active technology firm in Kansas is itself relatively likely (under existing conditions) to seek help from KTEC; and if it does, then its positive outcomes would be counted in the ROPI model.<sup>21</sup>

### **Time frames, time periods, and discounting**

All of the ROPI values and cost-effectiveness measurements reported in the next section refer to a time frame which begins with the inception of KTEC (about 1987) and extends through fiscal 1994-95. The costs include all costs of KTEC incurred during that period. The “realized” benefits include all benefits that occurred through 1994.

All benefits and costs are discounted to yield present values as of 1994. The real discount rate is assumed to be 12%. The particular choice of 1994 as opposed to some other target year does not affect the ROPIs (benefit-cost ratios) or the cost-effectiveness measure because changing the target year would affect the numerator and denominator proportionately.

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<sup>21</sup> However, in cases where KTEC’s measured attribution is less than 100 percent, the attribution would tend to be understated in the ROPI model, since we did not consider indirect attribution. Moreover, not all technology firms seek KTEC’s help. These points may be addressed by future research in economic modeling.



The cost-effectiveness measures are denominated in 1994 dollars.<sup>22</sup> This does not affect the ratios for dollar-denominated outcomes, but it does affect the reported ratios for real outcomes. That is, the number of jobs or patents generated by a million budgetary dollars changes, of course, whenever the real value of the million dollars changes.

### **The degree of causality attributed to KTEC is estimated from surveys**

It is one thing to observe that a given firm helped by KTEC experienced some significant success; it is quite another to attribute that success to KTEC. In the ROPI model, KTEC's degree of credit for causing the firm's success is treated as a variable that varies between 0 and 100%, rather than as an on-off switch. This percentage is based on a judgment provided by the firm itself—that is, by an individual who is presumably in the best position to know. In particular, each survey of firms contained a version of this question:

To what extent would you attribute the employment, sales, and other activities listed above as resulting from (the Center's) services or facilities? Please use a scale of 1 through 10 with 1 indicating that (the Center) had almost no role, and 10 indicating that the activities could not have been undertaken without (the Center).

Numeric responses to this question were interpreted as an estimate of the percentage of causality that is due to KTEC.<sup>23</sup> All results attributed to KTEC in the ROPI model have been discounted by this percentage. (For a discussion of the validity of this attribution model, see Chapter 7.)

### **This report adopts a “lower bound” approach to handle measurement accuracy**

No measurement is or can be exact. Given finite resources, even after researchers make the best effort they can to reduce measurement errors, some error always remains. Therefore, researchers have an obligation to report the expected degree of measurement error to the end users of their research. Reporting measurement errors is a very important problem, one that economists need to address more carefully in the future than they ordinarily have in the past.<sup>24</sup> Two possible approaches to this task are to provide a direct measurement of all measurement errors, or else to provide some kind of upper and/or lower bounds on the measurement.

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<sup>22</sup> This is a different question than that of the target year; we could, for example, quite consistently calculate present values as of 1994 and then denominate them in terms of 1995 dollars.

<sup>23</sup> The responses were rescaled onto a scale of 0 to 100.

<sup>24</sup> Most economists are careful to report the standard errors of statistical estimators and other errors that result from having a finite sample. In cases of forecasting a routine time series, economists have also developed measurements of total forecasting error. However, in most cases economists estimate neither errors in the underlying data nor errors in the model.

In this report we attempt to provide a lower bound measurement of the benefits of KTEC, and hence a lower bound measurement of ROPI. This measure simply omits all the social benefits associated with firms that failed to respond to our survey. We believe this lower bound measure is a more reliable indicator of ROPI than measures which attempt to adjust for social benefits associated with non-respondents. Using the lower-bound measure also tends to create an incentive for KTEC program administrators to take steps so that their most successful clients do respond to the survey. (For example, steps are underway in the various agencies to require in advance that all major client firms respond to surveys.)<sup>25</sup>

The use of a lower bound ROPI measure is a conservative way to evaluate KTEC as a whole. It places the full burden of proof on KTEC to show that its outcomes are sufficiently beneficial to justify KTEC's costs. For comparisons between individual KTEC programs, use of a lower bound measure creates a level playing field in which agencies are judged by their actually known outcomes.

There are other kinds of errors in addition to non-response errors. One kind in particular is the innate measurement error in any multiplier model. However we believe that multiplier errors are substantially less important than non-response errors. In part this is because the same multipliers are used in the numerator as in the denominator, so that multiplier errors tend to cancel out. In addition, multiplier errors are constant across the agencies being compared, so that they are likely to have small effects on *relative* rankings of programs, in most cases.

Another kind of error is mistakes by firms on the survey questionnaire. There could be mistakes in the reported amount of economic activity associated with the project that KTEC assisted. Most importantly, there could be errors in KTEC's reported share of responsibility for success of the project, because that responsibility may be hard to allocate.

As in most other evaluation studies, we do not account for questionnaire errors because we have no way to estimate their amount. We can only state that we have tried to construct our questionnaires as carefully as we can, that our surveys are similar to other survey research, and that external sources of data have not indicated that our estimates are in error.

### **Many lower bound or conservative assumptions are used**

The main ROPI metrics in this report are calculated using lower bound assumptions, because that provides the most credible measure of success. In particular:

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<sup>25</sup> We could also have calculated upper bound measures, but did not because it would not be helpful. The upper bound would generally be much larger than the lower bound, because it would have to allow for the possibility that the non-respondents included some projects with very large social benefits. Because non-respondents are believed to consist disproportionately of unsuccessful projects with low social benefits, we expect that the true values are much closer to the reported lower bound than to such an upper bound.

- Anticipated future benefits are ignored.
- Benefits are discounted by an “attribution rate” (i.e., multiplied by the share of credit that is due to KTEC, according to the client firm).
- Benefits and costs are discounted over time. (Since costs occur before the benefits are accrued, this practice tends to reduce the benefit-cost ratio.)
- The discount rate is set at 12%, a relatively high rate for studies of this kind. (A higher discount rate leads to a lower BCR, again because benefits occur later in time than costs.)
- *All* KTEC costs are included. (In particular, costs are included for projects just getting started that have no benefits as yet.)
- Benefits count only from verified outcomes (e.g., outcomes verified by surveys actually returned by clients of the program). There is no correction for survey non-response.
- The use of third-party surveys may tend to reduce the enthusiasm of survey respondents.
- Benefits received by non-residents of Kansas are omitted.

## 6. ROPI RESULTS

The main results of the study are shown in Tables 6.1 through 6.3. Table 6.1 shows lower bound estimates of the overall impacts of KTEC operations on each indicator in present value terms, net of opportunity costs. Table 6.2 shows the present value net impact on each indicator per \$M in funds supplied by the state of Kansas. Table 6.3 shows the benefit-cost ratios for each indicator, and also for weighted goals and for an over-all weighted indicator.

### **KTEC as a whole has been positively productive**

In terms of benefits that have already been realized from KTEC activities, KTEC as a whole was found to be quite productive. Here are some lower-bound ratios of benefits to costs for some of the indicators:

- In terms of jobs in Kansas, KTEC generated at least 5.8 jobs for every job forgone.
- In terms of Kansas income, KTEC generated at least 3.0 dollars of income for every dollar of income forgone.
- In terms of Kansas business taxes, KTEC generated at least 4.9 dollars of revenues for every dollar of business tax revenue forgone.
- In terms of workforce skills in Kansas, KTEC generated at least 6.8 years of experience and education for every year forgone.
- In terms of patents granted in Kansas, KTEC generated at least 41 patents for every patent forgone.
- In terms of a weighted indicator based on 14 statewide results of economic development in Kansas, KTEC generated an increase of at least 14% of the aggregate indicator for each 1% forgone.

These ratios are “Realized ROPI” values, meaning that the benefits have already been received. In addition, substantial benefits can be anticipated in the future from KTEC dollars previously spent. In other words, the Anticipated ROPIs are substantially larger than these Realized ROPIs.

Here are some measured rates showing the overall effectiveness of KTEC budgetary dollars. For every \$1M the State of Kansas has spent on KTEC programs, KTEC has already generated a *net* outcome (i.e., benefits less costs) of at least:

- 65 jobs lasting one year in Kansas (or the equivalent, such as 5 jobs lasting 13 years. (These jobs are counted only if they are filled by persons already living in Kansas);
- \$2.2M dollars of Kansas income;
- \$100,000 dollars of Kansas business tax revenues;
- about 1/4 of a new patent granted in Kansas; and
- 250 years of workforce experience and education added to the Kansas work force.

**Table 6.1**  
**Net Economic Impacts**  
(Direct plus indirect benefits less costs)  
Lower bounds; e.g., future benefits excluded. see text.

	AMI	CECASE	CDDP	HBC	NIAR	Ad Astra	ARMF	MAMTC	Total KTEC
<b>INDICATORS</b>									
Manufacturing Start-ups (units)	0.04	0.54	0.32	1.68	1.32	11.63	15.89	0.06	31.49
Five Year Survivals (units)	0.03	0.01	0.01	0.07	0.58	0.07	0.50	0.03	1.30
Fed. Funds for (R&D) (millions \$)	2.75	1.21	0.09	10.56	10.57	0.03	0.32	5.32	30.84
Private Mnf. Investment (millions \$)	0.23	0.04	0.16	0.16	1.21	0.36	4.11	0.10	6.36
Business taxes (millions \$)	0.19	0.11	0.04	0.69	5.25	0.26	1.74	0.29	8.56
Patents Issued (units)	0.65	1.07	0.30	1.21	1.01	2.00	14.70	0.06	21.01
Infrastructure (millions \$)	1.9	1.1	0.4	7.8	45.6	1.1	11.9	3.3	73.1
Workforce Training (number of students)	4.4	1.8	1.3	11.8	214.7	9.4	67.4	5.6	316.3
Human Capital Stock (years of experience)	1,220.	576.	348.	3,965.	10,664.	581.	3,318.	1,233.	21,904.
Good Jobs - Income (job-years)	163.	80.	46.	541.	1,557.	82.	451.	166.	3,085.
Good Jobs - Titles (job-years)	132.	62.	40.	417.	1,235.	83.	421.	154.	2,544.
Good Jobs - Education (job-years)	108.	54.	31.	365.	905.	55.	255.	105.	1,878.
All Jobs (job-years)	293.	141.	85.	963.	2,838.	153.	899.	317.	5,688.
Personal Income (millions \$)	3.9	2.5	0.4	20.6	116.7	2.1	29.1	7.8	183.0
Source: IPPBR									

**Table 6.2**  
**Cost-Effectiveness Ratios**  
 (Net benefits per budgetary \$M)  
 Lower bounds; e.g., future benefits excluded. see text.

INDICATORS	AMI	CECASE	CDDP	HBC	NIAR	Ad Astra	ARMF	MAMTC	Total KTEC
Manufacturing Start-ups (units)	0.068	0.071	0.093	0.130	0.004	0.652	1.100	0.012	0.246
Five Year Survivals (units)	0.002	0.031	0.004	0.004	0.003	0.021	0.006	0.006	0.015
Fed. Funds for (R&D) (millions \$)	0.018	0.570	0.586	0.289	0.258	0.013	0.003	1.099	0.317
Private Mnf. Investment (millions \$)	0.034	0.065	0.009	0.010	0.021	0.169	0.034	0.020	0.073
Business taxes (millions \$)	0.009	0.283	0.039	0.026	0.017	0.071	0.024	0.060	0.100
Patents Issued (units)	0.064	0.055	0.067	0.256	0.062	0.603	0.190	0.012	0.236
Infrastructure (millions \$)	0.09	2.46	0.43	0.27	0.18	0.49	0.11	0.68	0.85
Workforce Training (number of students)	0.27	11.59	0.65	0.44	0.42	2.76	0.89	1.16	3.75
Human Capital Stock (years of experience)	74.	576.	220.	138.	115.	136.	55.	255.	250.
Good Jobs - Income (job-years)	10.	84.	30.	19.	15.	19.	8.	34.	35.
Good Jobs - Titles (job-years)	8.	67.	23.	15.	12.	17.	8.	32.	29.
Good Jobs - Education (job-years)	7.	49.	20.	13.	10.	10.	5.	22.	21.
All Jobs (job-years)	18.	153.	53.	34.	28.	37.	14.	65.	65.
Personal Income (millions \$)	0.07	6.30	1.14	0.59	0.37	1.19	0.20	1.62	2.15
Source: IPPBR									

**Table 6.3**  
**Benefit-cost ratios**

(Total benefits per total costs)

Lower bounds; e.g., future benefits excluded. see text.

	AMI	CECASE	CDDP	HBC	NIAR	Ad Astra	ARMF	MAMTC	Total KTEC
<b>INDICATORS</b>									
Manufacturing Start-ups (units)	1.8	26.4	14.2	19.2	14.9	215.8	128.4	3.4	65.1
Five Year Survivals (units)	2.4	2.7	2.0	2.8	16.3	4.1	11.0	4.0	7.6
Fed. Funds for (R&D) (millions \$)	41.1	45.9	3.8	91.8	89.5	1.5	3.0	171.4	50.9
Private Mnf. Investment (millions \$)	6.4	3.6	9.5	3.2	17.4	9.5	43.4	6.1	17.7
Business taxes (millions \$)	1.8	2.1	1.4	2.7	13.4	2.1	4.1	3.6	4.9
Patents Issued (units)	12.1	47.2	12.6	13.1	10.9	35.3	110.1	3.2	40.7
Infrastructure (millions \$)	1.7	2.0	1.3	2.6	10.3	1.4	2.8	3.6	3.9
Workforce Training (number of students)	2.2	2.3	1.8	2.9	34.1	3.5	8.9	4.3	10.4
Human Capital Stock (years of experience)	3.7	4.2	2.7	6.1	14.5	2.3	4.2	7.0	6.3
Good Jobs - Income (job-years)	3.4	4.0	2.5	5.7	14.1	2.2	3.9	6.4	6.0
Good Jobs - Titles (job-years)	3.7	4.2	2.9	6.1	15.6	2.7	4.8	8.0	6.8
Good Jobs - Education (job-years)	3.5	4.2	2.6	6.0	13.2	2.3	3.6	6.4	5.9
All Jobs (job-years)	3.2	3.7	2.5	5.3	13.4	2.2	4.0	6.3	5.8
Personal Income (millions \$)	1.4	1.6	1.1	2.2	7.7	1.2	2.3	2.7	3.0
<b>GOALS</b>									
1. Good business climate	18.1	26.7	5.2	39.3	42.1	26.1	30.0	67.3	32.9
2. Good jobs	3.2	3.6	2.4	5.0	21.1	2.7	5.8	6.1	7.7
3. Total jobs	3.6	4.1	2.7	5.9	14.3	2.4	4.1	6.9	6.2
4. Highly skilled workforce	3.2	3.7	2.5	5.3	13.4	2.2	4.0	6.3	5.8
5. Income and wealth	1.4	1.6	1.1	2.2	7.7	1.2	2.3	2.7	3.0
<b>WEIGHTED TOTAL</b>	7.7	10.7	3.0	15.7	22.4	9.8	12.3	25.3	14.2

Source: IPPBR

## **Each individual KTEC program has been positively productive**

With respect to the particular KTEC agencies examined, it was found that every agency has been positively productive with respect to every indicator. The NIAR agency has been the most productive in a number of important respects, including generating income and jobs, and especially in generating good jobs that pay well or have high amounts of human capital. The Ad Astra agency has been particularly effective at encouraging manufacturing startups. The MAMTC agency has been particularly effective at leveraging federal dollars. The AMI, CECASE, and CDDP agencies lag behind the other agencies on most of the indicators. However, any relative rankings should be viewed with caution, because they could be sensitive to unknown benefits excluded due to survey non-response. CDDP, for example, scored much higher in the previous study, mainly because of a single large firm that responded then but not on the current survey. These issues are discussed further in Chapter 9.



## 7. THE ATTRIBUTION OF CAUSALITY

As we pointed out previously, a fundamental problem in evaluation is deciding whether observed outcomes are actually caused by the agency's activities, or whether they would have happened in any case. In the particular case of ROPI survey data, we attempted to estimate what fraction of an observed economic activity by a client firm should be attributed to KTEC intervention, using a survey question. The question asks the respondent to estimate that fraction directly (see Chapter 5 above). That survey response is critical to the ROPI results, and it depends on a judgment by the firm which could be inaccurate or biased. Therefore, it is important to obtain independent verification that these judgments are valid.

Two types of validity checks are possible for survey data. "Internal validity" exists if the survey results contain cross checks that lead to internally consistent conclusions. "External validity" exists if the survey results can be supported using independent evidence. This chapter discusses both types of validity checks. However, the main subject of this chapter is "external validity." In particular we will report an independent study of KTEC that was based on Kansas Unemployment Compensation Insurance records.

### **This study found internal evidence for the validity of the attribution measure**

As noted in Chapter 5, each surveyed firm was asked a version of the following question:

To what extent would you attribute the employment, sales, and other activities listed above as resulting from (the Center's) services or facilities? Please use a scale of 1 through 10 with 1 indicating that (the Center) had almost no role, and 10 indicating that the activities could not have been undertaken without (the Center).

Empirically, the responses to this question turned out to be highly positively correlated with responses to a question measuring the firm's degree of satisfaction with the agency's services (see Table 7.1). However, they were not significantly correlated either with the hours of effort put in by agency personnel or with the amounts paid by the client to the agency. These correlations are consistent with the hypothesis that firms are satisfied with the services they received if and only if the services are perceived to have increased the likelihood of a successful outcome. This positive correlation lends some support to the "internal validity" of the survey questions—that is, relationships within the survey results seem to be consistent with what we had intended the questions to measure.

On the other hand, another series of questions asked respondents a version of the following question:

If the services or facilities of [the agency] had not been available to your firm, what would you have done as your next best alternative?

(Please Select One Item)

- 1 would have forgone use of services
- 2 would have performed in house
- 3 would have used private firm in Kansas
- 4 would have used public or private out of state
- 5 other (please specify)

We had hypothesized that item 1, in particular, might be correlated with high values of attribution. As it turned out, none of the respondent's answers to this question were significantly related to attribution.<sup>26</sup>

**Table 7.1**  
**Regression of Attribution on Satisfaction**

Dependent variable	Attribution rate (scale of 1 to 10)
Constant	-0.19 (2.72)
Satisfaction (scale of 1 to 10)	0.655* (.226)
R Squared	0.268
No. of Observations	25
Notes: significance levels: * .01. Standard errors are in parentheses. Source: IPPBR.	

### **Previous studies provided external evidence for the validity of the attribution measure**

A more important question is that of external validity—i.e., whether outside evidence shows that the question really does measure what it is intended to measure. In other words, we would like to have independent evidence that KTEC really does cause the economic development that the model attributes to KTEC. In our previous ROPI study (Burress and Oslund [1994]), we addressed this issue in two ways.

First, we did an econometric study of large-scale changes in technological industries in Kansas and other states. This study was inconclusive; the existing aggregate data turned out to be statistically insufficient to show whether changes in Kansas technology development could or could not be attributed to KTEC activities. This result was not unexpected—it reflects the fact that KTEC is small in comparison to the Kansas economy. In particular, KTEC operations as a whole are under \$20M

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<sup>26</sup> In the future, we may try a similar question that includes an explicit alternative for canceling the project outright.

per year, while total investments in technology-related basic industry in Kansas are over a billion dollars per year.

In a second analysis we compared growth associated with KTEC with the total of all other growth in Kansas, which was assumed to be associated with Kansas government at large. This comparison showed that growth associated with KTEC is vastly greater than growth associated with Kansas government at large. This outcome supports the hypothesis that KTEC activities really do cause technology growth in Kansas. Again, however, KTEC's strong association with growth is not sufficient to prove KTEC's causation of growth.

This chapter addresses this critical issue using a third approach based on a statistical study of firms aided by KTEC. Using data from the Kansas Unemployment Compensation Insurance (UI) program, we examined whether firms aided by KTEC appear to perform any better than firms not so assisted.

### **The UI dataset provided new external evidence on validity**

The available unemployment compensation insurance data consisted of all detailed establishment-level records for 1988 through 1995. UI master files (the ES202 tapes) are generated by quarters; we selected out one quarter from each year (always the first quarter). The data include the employment of the establishment for each month in the quarter, and the total payroll of the establishment for the quarter. These data are likely to be very accurate because they constitute the tax base for the UI tax. The dataset covers all establishments in Kansas that have employees. Therefore, establishments consisting of a sole proprietor or partnership having no employees are not included.

The record also contains the SIC code of the establishment and its name and address. The SIC code is reported with reasonable accuracy at the one-digit level, because the UI tax rate depends on the one-digit SIC category of the establishment during the first few quarters after the establishment is first enrolled on the tax rolls. However, after that time, establishments are experience-rated and SIC codes are not used except in statistical reports. Changes in SIC codes are not audited with any care after the first year, and there could be errors in this data field. (In some cases we did find differences between SIC codes in the UI records and SIC codes in the corresponding KTEC records.)

### **Complex data linking was used to define the statistical "firm"**

For examining the activities of individual business firms over time, we needed to locate all of the UI records that relate to a particular business. A threshold problem is defining what is meant by a "firm." The unit of analysis adopted in this chapter is that of a single establishment existing across time. An "establishment" means one particular operation at one particular location; therefore a given firm may have multiple establishments. By definition, an establishment could have a sequence of different owners over time. Unfortunately for our purposes, the UI master files are not organized in

this fashion. Instead, a separate master file is constructed for each quarter, with only limited links between records across time. Therefore, we undertook to assemble records for each establishment across time, using all years it was represented in a UI master file in the first quarter of the year during the years 1988-1995.

That simple problem led into a complicated computer analysis of matches on record IDs. The unique ID for a UI taxpayer at a particular establishment is generally constant over time; however, it changes when the business is sold. Also, businesses may have multiple UI records if they have multiple business entities (“reporting units”) at a single location. Finally, the sheer size of the dataset (around a half million records) made it a bit unwieldy to analyze. However, we believe that this initial linking effort was largely successful.

Next, we linked our records for KTEC client firms into the UI dataset. The purpose of this link was to distinguish firms helped by KTEC from those that were not helped. This linking depended on matching names and addresses of firms, which is problematical because spellings and word choice in name and address fields often vary between different records. UI records that did not match any KTEC client were assumed not to be KTEC clients, and were used as the background “control” set for the statistical studies that follow.

A few KTEC clients could not be matched up with any UI records. In some cases the KTEC-assisted firm never had any employees and therefore no UI record existed. In other cases, there probably were UI records, but differences in spellings prevented a match. It follows that a few of the establishments we used as “control” establishments may actually have been KTEC clients. That could lead to our statistical models very slightly understating the differences between KTEC clients and other firms. However, because the unmatched KTEC clients constitute at most a very tiny share of the control establishments, this problem is not significant.

About 354 KTEC clients were successfully matched into the UI dataset. However, because of various selection criteria smaller numbers of KTEC clients could actually be used in the various statistical tests reported below. For example, in some of the statistical models an important variable is the year in which KTEC first intervened to help the firm. Because of limitations in administrative records maintained by some of the KTEC programs, intervention dates were not always available. In other models, we restricted to establishments that had UI records in both 1988 and 1994, or in other combinations of years.

### **There is evidence that KTEC increased the growth rates of establishments**

Regression models showed that employment and inflation-corrected payroll in establishments that had been assisted by KTEC grew significantly faster during 1988-94 or 95 than establishments not so assisted. This pattern continues to hold up for each category when the establishments are broken

out into three groups by SIC code. (For typical regressions, see Table 7.2.) The growth rate was about 5% per year faster in KTEC-assisted establishments.

**Table 7.2**  
**KTEC Intervention and Growth of Establishments**

	Model 1	Model 2	Model 3	Model 4
dependent variable	payroll 1994	log payroll 1994	log employment 1994	log employment 1994
intercept	\$23,500 (1364) ***	.925 (.030) ***	.193 (.007) ***	.1784 (.0069) ***
payroll 1988	.996 (.001) ***			
log payroll 1988		.927 (.003) ***	.917 (.003) ***	
log employment 1988				.918 (.003) ***
SIC code < 3600				.0756 (.0102) ***
3600 < SIC code <4000				-.0070 (.0461)
KTEC intervention	\$164,000 (20,000)***	.331 (.074) ***	.323 (.058) ***	.433 (.186) #####
R <sup>2</sup>	.979	.811	.794	.794
Notes: significance levels: *** .0001; **.001; * .01; ##### .02; ### .05; ## .1; # .2 Standard errors are in parentheses. Sample includes 109 KTEC interventions and 21,300 other establishments Source: IPPBR				

A similar pattern holds up for each individual KTEC agency (see Table 7.3). The results are always significant to at least the 10% level of significance, but usually at a much higher level of significance. (The lower significance levels simply reflect very small samples of assisted establishments for certain combinations of years, industries, and programs.)

**Table 7.3**  
**KTEC Intervention by Agency and Sector**

	Model 5	Model 6	Model 7	Model 8
selected sample	SIC code < 3600	3600 < SIC code <4000	4000 < SIC code	all establishments
dependent variable	log employment 1994	log employment 1994	log employment 1994	log employment 1994
intercept	.336 (.017) ***	.047 (.120)	.1596 (.0071) ***	.1784 (.0068) ***
log employment 1988	.865 (.008) ***	.974 (.038) ***	.929 (.003) ***	.917 (.003) ***
SIC code < 3600				.0756 (.0102) ***
3600 < SIC code <4000)				.0010 (.0463)
AMI	.580 (.237) #####	.131 (.512)		.433 (.186) #####
CDDP	.209 (.410)	1.136 (.721) ##	.422 (.561)	.574 (.270) ###
CECASE	-.513 (.482)		.323 (.156) ###	.245 (.151) ##
HBC			1.677 (.438) ***	1.31 (.431) *
MAMTC	1.04 (.663) #			1.021 (.584) ##
NIAR	.439 (.139) **	-.113 (.184)	.243 (.177) #	.198 (.084) #####
ARMF	.712 (.221) **	.339 (.422)	-.1411 (.1870)	.226 (.125) ##
R <sup>2</sup>	.738	.813	.807	.794
Notes: significance levels: *** .0001; **.001; * .01; ##### .02; ### .05; ## .1; # .2 Standard errors are in parentheses. Sample for all SIC codes includes 109 KTEC interventions and 21,300 other establishments. Source: IPPBR				

**Table 7.4**  
**KTEC Intervention and Changes in Growth Rates of Establishments**

	Model 9	Model 10	Model 11	Model 12
dependent variable	log(payroll 1995 /payroll 1994)	log(payroll 1994 /payroll 1992)	log(payroll 1994 /payroll 1992)	log(payroll 1994 /payroll 1992)
intercept	.00273 (.00243)	-.00976 (.00277) **	-.0103 (.0031) **	.0331 (.0037) ***
log(payroll 1989 /payroll 1988)	-.00455 (.00683)			
log(payroll 1990 /payroll 1988)		-.0260 (.0066) ***	-.0260 (.0066) ***	
log(payroll 1991 /payroll 1989)				-.0231 (.0064) **
SIC code < 3600			.0058 (.0071)	-.00512 (.00839)
3600 < SIC code <5000)			-.0916 (.0316) *	-.0685 (.0364) ##
KTEC intervention	.1062 (.0644) #	.1328 (.0399) **	.152 (.041) **	.1033 (.0477) *
R <sup>2</sup>	.0002	.0013	.0017	.0009
Notes: significance levels: *** .0001; ** .001; * .01; ### .05; ## .1; # .2 Standard errors are in parentheses. Sample size varies with the model. Source: IPPBR				

While these results shows an association with growth, we can't be absolutely certain there is a causation of growth. One impediment to this conclusion is the possibility that KTEC tends to help establishments that were already fast-growing before KTEC intervened. This might happen, for example, if fast-growing establishments were more likely than other establishments to seek out KTEC's help. To test for this possibility, we controlled for the rate of growth of the establishment during 1988-89, which was prior to KTEC's assistance. (See Table 7.4. We removed a few more establishments from the sample that were assisted during 1988 or 1989.) Once again, we found that KTEC establishments grew significantly faster than non-KTEC establishments. KTEC intervention appears to increase the annual growth rate in manufacturing establishments by about 5 percentage points per year.

Since these regressions control for initial level or initial growth rate of establishments prior to KTEC intervention, they do support the existence of a causal connection, and not merely an association, between KTEC intervention and growth. Still, a committed skeptic could find room for doubt. For example, our studies do not foreclose the possibility that ordinary establishments sometimes have a sudden conversion experience and initiate many simultaneous steps to encourage growth. Since KTEC help is freely available, establishments of this type would take advantage of its services. Since (by hypothesis) these establishments consulted KTEC immediately after their conversion experience, controlling for previous growth in their case is irrelevant. If, by hypothesis, establishments of this type constitute a high fraction of KTEC clients, then the observed association between KTEC and growth would fail to prove any causation.

This story seems implausible because of the long string of unverified assumptions that is required to make it true. For example, the story requires that establishments undergoing a growth conversion are relatively numerous among KTEC clients, in comparison with establishments that do not have recent changes in their prospects for growth. Also, the story requires that these firms gave false information on the ROPI surveys about KTEC's share responsibility for their success. We think that the most plausible interpretation of these results is that KTEC really does cause increased growth in its clients.

### **There is evidence that KTEC improved the 5 year survival rates of establishments**

An independent question is whether KTEC-assisted establishments are likely to survive longer than other establishments. Table 7.5 gives statistics comparing the survival rates of KTEC-assisted establishments with other establishments in Kansas for a period of 5 years after the intervention took place. The table controls for manufacturing versus nonmanufacturing establishments and also for size of the establishments. An approximate t-statistic can be calculated from the given data and is shown in the table.<sup>27</sup>

The table shows that among *non*-manufacturing establishments, KTEC intervention appeared to be associated with a *lower* than average survival rate; however, the association was not statistically significant. Among manufacturing establishments, KTEC intervention was associated with a *higher* than average survival rate, and the result was highly statistically significant. In particular, the data are consistent with the conclusion that roughly 35% of manufacturing establishments assisted by KTEC survive 5 years, but would not have survived otherwise. (An additional 45% would have survived even in the absence of KTEC intervention.) KTEC appears to be especially helpful for manufacturing establishments with less than 25 employees, raising their survival rate by some 40 percentage points. All of these associations are statistically significant.

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<sup>27</sup> Let  $N_{k+}$  denote KTEC survivors;  $N_{n-}$  denote non-KTEC non-survivors; etc. The test statistic is  $[N_{k+}N_{n-} - N_{k-}N_{n+}] / \text{sqrt}[(N_{k+}+N_{n-})(N_{k-}N_{n+}N_{n-})]$ .



**Table 7.5**  
**Effects of KTEC Intervention on 5 Year Survival Rates**

class of establishments	KTEC intervention: count survival rate	No intervention: count survival rate	1-tailed test statistic (approx. t) significance level
all types	40 .625	33918 .452	2.20 .014
non-manufacturing	17 .353	32303 .451	.809 .209
5000 ≤ SIC code ≤ 5999	11 .364	12089 .449	.567 .285
all manufacturing	23 .826	1615 .471	3.39 .00035
manufacturing, <100 employees	15 .867	1445 .457	3.17 .00077
manufacturing, <50 employees	9 .889	1353 .446	2.66 .0039
manufacturing, <25 employees	7 .857	1223 .428	2.29 .011
Source: IPPBR			

This kind of association is evidence that KTEC really is *causing* prolonged survivals among its clients. Additional evidence is provided by the survival pattern with respect to size of the establishment; it seemed likely that KTEC's impact on a small establishment would be greater than its impact on a large establishment (because KTEC's intervention constitutes a relatively more significant resource in the former case), and that is exactly what was found.

Once again, this observed association is not conclusive proof that KTEC intervention causes increased survival. An alternative explanation is that firms that are especially likely to survive, also are especially likely to seek KTEC help. While we can't absolutely disprove that interpretation, several considerations suggest otherwise. First, if the fittest firms are self-selected as clients, then it is hard to see why small firms are more strongly associated with improved survival rates than large firms. On the contrary, one would expect that large successful firms would be especially well situated to seek out whatever advantages KTEC can offer. Second, once again this interpretation cannot explain why ROPI survey respondents give a large positive share of credit to KTEC. The simplest interpretation is that KTEC really does substantially improve the chances of survival by its manufacturing clients.

## **Evidence on causation of start-ups was positive but inconclusive**

We also examined the relationship of KTEC intervention to the number of start-ups of new technology-related establishments. We found in general that the total number of startups in a given year and in a given 1-digit SIC code class is positively and significantly related to the number of start-ups assisted by KTEC. However, we view those models as generally inclusive, because the data set did not contain any good independent predictors of startups. For that reason we do not report those results here.

## **Conclusion: the evidence on attribution is positive and consistent**

Survey results, internal validity checks, and external regression studies lead to similar conclusions. All the present evidence without exception either supports, or at least does not contradict, the hypothesis that KTEC intervention has had strongly positive economic effects on Kansas firms.

At the same time, we point out that all of our data is based on outcomes of the usual operations of KTEC—that is, we are using “natural experiments” rather than true controlled experiments. Measurements of causal relationships based on such data are never entirely conclusive—rather, interpretations must depend upon a preponderance of the evidence. Questions of causation would best be settled by means of controlled experiments, which we have not done.<sup>28</sup> Unfortunately, administrative experiments using randomly selected control groups may be difficult to reconcile with the purposes and ideals that we expect agency administrators to uphold, such as fairness and universal service. To our knowledge, there have been no controlled experiments in technology transfer. An actual experimental evaluation of technology transfer using randomly selected treatment and control groups would, of course, be of very great interest, not only to specialists in technology transfer, but also to those engaged in economic development in general and in other types of evaluation as well. Controlled experiments would be especially valuable if they could be used to benchmark non-experimental evaluation methods. But until that happens, evaluators will have to be content with non-experimental and quasi-experimental studies like this one.

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<sup>28</sup> See Burtless [1995]. Or see Jaffe [1998], who states:

...if we really desire to know how effective [technology] programs are, then the programs need to incorporate elements of experimental design into their ongoing operation, in the same way that the efficacy of drugs is determined by scientifically-designed clinical trials.

But not even controlled experiments can provide a panacea. Because of difficulties in ensuring that social experiments are actually conducted in the manner planned, some of the same problems of sample selection bias may occur, and regression models are needed to test for those possibilities [Heckman and Smith, 1995]. In the end, interpreting social causation *always* depends on a preponderance of the evidence, rather than on a decisive proof. Experimental data are simply more persuasive than other data.

## 8. COMPARISONS WITH OTHER STUDIES AND PROGRAMS

To make sense of KTEC outcomes, we need to compare our ROPI results with other studies of economic development and technology transfer programs. Unfortunately, comparisons across studies are very difficult to perform because of vast differences in concepts and methodologies. Many different adjustments are needed in order to make the study results comparable to each other, and quite often these adjustments need to be extremely large. The adjustments are also highly technical. Moreover, many of the available studies are not of very high quality, and the data needed for making adjustments are spotty at best. In this chapter we make some adjusted comparisons between KTEC and other programs. Because of the limited availability of data needed for adjustments, the following comparisons are necessarily very rough.

### The cost per job is hard to compare across studies

The most common figure of merit used in economic development evaluations is the cost to the public of creating one job. Unfortunately, the cost of a job is a truly slippery concept, and careless comparisons across studies can be extremely misleading. There are at least nine important differences in measurement methods, each of which can have large to very large effects on the result.

- Multiplier effects: some studies include them and some do not. Moreover, multipliers might be applied either to jobs, or to costs, or to both. Moreover, multipliers if included are very sensitive to the jurisdiction being analyzed.
- Attribution: the studies most commonly assume that 100% of the observed jobs are caused by the agency's intervention. This practice understates the true cost of a job. For example, in cases where the true attribution rate is only 50%, the job-cost should be doubled.
- How long the jobs will last: job creation numbers are usually measured by assuming the jobs will last forever, but of course that is not the case. Construction jobs generated by economic development, for example, typically last for only around a year. Adding long-term jobs to short-term jobs creates an "apples and oranges" problem. The best studies account for differences in the length of a job by aggregating "job-years" (i.e., the total of the years that each job actually lasted) instead of jobs.
- Discounting: most studies do not discount jobs over time, even if they occur with some delay after the cost is expended. Ideally they *should* discount the jobs, because jobs in the future are worth less now than jobs in the present. Moreover, if costs extend across time then they should also be discounted. The ROPI model used in this study discounts both jobs and costs at a rate of 12% per year.
- Gross jobs versus net jobs: many studies use a gross measure of jobs, i.e., one which does not net out the jobs *lost* because of the dollars pulled out of the local economy to pay for the incentive program. Gross jobs can be an extremely misleading measure, because a agency that actually loses jobs will be reported as creating positive gross jobs.. The ROPI model uses a net measure.

- Gross cost versus net cost: most studies use a gross budget cost that ignores any net tax revenues generated by the project. For many purposes it would make more sense to use a net fiscal impact measure of cost—defined as gross budget cost less new tax revenues plus expenditures for any new services necessitated by growth caused directly and indirectly.
- Leveraged costs: some studies include dollars leveraged from federal sources in the job-cost; but ROPI does not (since that is not a cost to the State of Kansas). There can also be leveraging between state and local resources.
- Inflation: cost data taken from different years need to be corrected for the price level.
- Bias and measurement error: studies differ greatly in the quality of the underlying data. For example, job creation as reported by program administrators is likely to be more optimistic than job creation as reported to a neutral third party investigator by agency clients. There may also be large differences in the timeliness of data gathering (e.g., surveys taken long after the fact tend to understate job creation because of memory loss), and large differences in sample response rates. The cost data may be subject to incompleteness, conceptual errors, and accounting errors. Multipliers are especially susceptible to being mis-measured and overstated.

The adjustments needed to address all these problems can be very large; they can turn an apparently very good program into an apparently very bad program, or vice versa.

*We have attempted to adjust job-costs to a common standard*

In the comparisons that follow, we will attempt where possible to adjust the results to a very rough common standard. In particular, whenever possible we will convert the numbers so as to approximately exclude multiplier effects; account for attribution; report job units in terms of permanent jobs rather than job-years; discount for delays; use net rather than gross jobs; use gross rather than net budget costs; exclude leveraged federal costs; and adjust costs to a 1994 dollar basis. In addition, to make a fair comparison, we will assume that KTEC jobs (and other jobs as well) will in fact last forever.<sup>29</sup> However, in most cases we can give what is at best only a qualitative discussion of attribution and measurement error.

*KTEC's standardized job cost*

The job measures used in the ROPI study are “discounted job-years.” This measure employs very conservative<sup>30</sup> assumptions on how long the job will last, then takes a net present value of the stream

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<sup>29</sup> This standard partly represents what is appropriate for state-level policy analysis (discounting for time, discounting for attribution, excluding leveraged federal costs, using net jobs) and partly represents what is simple to implement (jobs that last forever are assumed in most studies; gross budget costs are used in nearly all studies; multipliers when used at all are not comparable across studies).

<sup>30</sup> Recall for example that realized ROPI uses only the jobs observed in the past, and not their extension into the future; i.e., all jobs are assumed to terminate today.

of job-years. It can be shown ROPI job-years should be multiplied by around 3/8 to convert them into units of simple jobs assumed to last forever.<sup>31</sup> In addition, ROPI uses multipliers that imply job/job multipliers of around 1.5.<sup>32</sup> That leads to an overall correction in which ROPI job-years should be multiplied by about 1/4 to generate standardized units of simple jobs assumed to last forever, net of multiplier effects.

Using data from Table 6.2, an upper bound on KTEC budget costs is about \$15,000 per net ROPI job-year. After removing multiplier effects and discounting, this is equivalent very roughly to a standardized cost of \$60,000 in budgetary costs per *net* job that lasts forever.<sup>33</sup> Note that this is an upper bound estimate that correctly accounts for attribution, discounting, and net job loss due to the opportunity-cost of the KTEC budget. These corrections lead to a much higher cost figure than would be obtained under more commonly used methodologies.

As yet, few studies have quantified the costs per job specifically for technology transfer programs. Studies of other types of economic development programs have found an extremely wide range for the public cost of generating one job.

*Kansas, Inc. data suggest that KTEC is superior to several other Kansas programs*

Kansas, Inc. collected job creation and state budget costs for various Kansas state economic development agencies [Miller *et al.*, 1996]. The study collated a large amount of very useful data, but by design did not collect all the needed data nor attempt the kind of analysis that would be required for a full evaluation of individual programs.

Some of the limitations of the dataset do not preclude useful comparisons across programs. In particular, the data do not include multiplier effects nor additional costs paid by local government, but these limits can be ignored. Other limitations can be handled using approximate adjustments:

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<sup>31</sup> A typical KTEC job that has lasted four years has generated about 1/3 the present-value job-years as a job that will last forever (because  $PV(1, 12, 4)/PV(1, 12, \infty) = .35$ .) Hence if we assume (at least for comparison purposes) that the KTEC job really will last forever, then the ROPI number of job-years should be multiplied by  $1/.35 \approx 3$  to provide a comparable standardized number of P.V. job-years. But now we also have to convert units of P.V. job-years into units of simple jobs that last forever. To do that we divide by the present-value job-years that would be generated by one job that lasts forever. This factor is approximately 8 (because  $PV(1, 12, \infty) = 8.33$ ). The upshot is that ROPI job-years should be multiplied by roughly 3/8 to yield standardized jobs assumed to last forever.

<sup>32</sup> A "job/job" multiplier refers to the ratio of total jobs created to job directly created by an intervention. We have actually used what might be called "job-year/job-year" multipliers because they are more precisely defined.

<sup>33</sup> This corresponds to roughly \$35,000 per gross job. Costs per gross jobs is what is usually reported.

- The study used gross jobs rather than net jobs; we can correct to net jobs by assuming an opportunity cost of about 12 jobs per budgetary \$1M (in 1994 dollars, a figure taken from ROPI model data).
- The data were not corrected for inflation; we adjusted our results to 1994 dollars.
- The data were not discounted over time. We discounted for the pattern of financing and job reporting over time.

In several respects, the data have limitations that cannot be corrected for:

- Since the delay between funding and job creation was not reported, we could not completely correct the data for discounting.
- The study did not attempt to correct the data for attribution.
- Short-term jobs were not distinguished from permanent jobs.
- The data were from administrative records rather than from third party surveys of clients; we were not able to correct for any biases this may cause.

In a separate analysis [Burrell and Oslund, 1998], we calculated a lower bound on the job-cost, and an upper bound on jobs per budget dollar, by assuming the attribution rate was 100% and the reporting of jobs was accurate. It follows that these adjusted results substantially overstated the quality of the various agencies as compared with the ROPI-based measure.

Several points about the results of our analysis are worthy of discussion. First, we found an extreme variation in reported results across programs. However, because of measurement problems discussed above, and especially the problem of attribution, the exact significance of this variation is not clear. We will discuss this point further below.

Second, some agencies appeared to be negatively productive. In particular, the High Performance Firms Initiatives Program (HPIP), and the Kansas Value Added Center (KVAC; no longer active as such) produced negative net jobs after we corrected for job losses due to the opportunity cost of the program. Correcting for attribution would have made these agencies appear even worse. Since we were using an outer bound measure, in all probability these two agencies really were counterproductive with respect to producing jobs.<sup>34</sup>

Third, four KTEC agencies were studied by Kansas, Inc., namely ARMF, Centers of Excellence (all 5 are aggregated together), Seed Capital (Ad Astra I & II), and Mid-America Manufacturing Technology Center (MAMTC). These agencies were generally much more productive of jobs according to the adjusted Kansas, Inc. survey, than the same agencies appeared under the ROPI survey (i.e., \$7,000 to \$14,000 per job using the adjusted Kansas, Inc. figures, versus some \$60,000

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<sup>34</sup> This conclusion assumes, of course, that the relevant administrative records did not seriously understate job creation/retention for these programs.

per job according to ROPI). While there are many differences between the two methodologies, the most important difference has to do (once again) with attribution. That is, the Kansas, Inc. results count jobs which would occur even in the absence of the economic development program; the ROPI results do not.

Finally, several business service agencies were reported as being extremely productive of jobs, with apparent costs per net job of under a thousand dollars. The costs to the public per job were low because these agencies provide relatively modest services, typically brief training programs, with part of the cost often being shared by the client business. Indeed, if they are taken at face value as the true cost of retaining or creating a job, the public costs per job reported for these agencies are *so* low, and so consistently low across different training programs, as to defy credibility. In particular, it strains credulity to believe that the decision to build, retain or close down a production line hinges critically on a tiny one-time training subsidy amounting to well under 5% of the annual ongoing cost of the worker's salary and fringe benefits (letting alone the costs of capital, materials and marketing); moreover, to believe that this kind of knife-edge, all-or-nothing response occurs uniformly in the case of *each and every job* aided by a given economic development program; and, finally, to believe that this knife-edge response is observed in five or six separate government programs, and indeed in every agency that has a small direct cost per worker. A simpler explanation is that these figures merely represent the cost *associated* with *assisting* a job, and do not remotely represent the true cost to the state of *saving* a job.

The main implication of this discussion is that summaries of administrative records desperately need to be corrected for attribution before they are used in an evaluation of the agency. Equally importantly, there is an implication that the required adjustment for attribution can be expected to be very large for agencies that provide small-scale business services. Thus, there is an implication that administrative job creation figures are especially problematical for agencies that provide relatively small business services.

For the remaining agencies, the adjusted Kansas, Inc. figures implied that KTEC job-costs are at least roughly competitive with, or more than likely superior to, job-costs for other Kansas economic development agencies.

*"Smokestack chasing" leads to unreasonably high job costs*

There have been many cases nationwide in which large new manufacturing plants were attracted by a package of incentives. The costs to the state in these cases have risen rapidly of late and can be extremely high. The Nissan plant in Smyrna, Tennessee cost about \$11,000 in state and local incentives per direct gross job in 1984. That would be about \$13,000 per net job. (This assumes that the opportunity cost of taxes is around the Kansas figure of 12 jobs per \$1M.) The Subaru-Isuzu plant in Lafayette, Indiana cost about \$50,700 per direct gross job, which would imply roughly \$130,000 per net job. [Milward and Newman, 1989]. The BMW plant in South Carolina cost about

\$68,000 per gross job in 1992, which would imply around \$370,000 per net job. [South Carolina State Development Board, 1992].

In the following cases, the jobs lost due to opportunity cost may have exceeded the jobs that were created, meaning that each transaction actually reduced total jobs in the state. The Mercedes plant in Alabama cost about \$200,000 per gross job [New York Times, 1993], which could imply that something like 7 jobs were *lost* on net for each \$1M spent. The Ipsco steel plant cost Iowa about \$243,000 per gross job [Wall Street Journal, 1994], which could imply that 8 net jobs were *lost* per \$1M spent. The general Motors plant in Kansas City, Kansas cost about \$340,000 per job [Lester and Nicely, 1995], which could imply that 9 net jobs were *lost* per \$1M spent. The Methanol One plant in Alabama is reported to cost between \$300,000 and \$3.3M per gross job, which could imply 9 to 12 net jobs *lost* per \$1M; and the Blue Water Fiber plant in Port Huron, Michigan cost about \$2.4M per gross job gained, or 11 net jobs *lost* per \$1M [both are cited in National Lawyer's Guild, 1995]. (However, fully analyzing these cases would require a detailed consideration of the multiplier effects and tax revenues generated by the various projects.)

The portion of these jobs caused through indirect or multiplier effects are not available in some cases (hence some of these job costs may actually be understated). These figures also were not corrected for attribution (i.e., the possibility that the firm would have located its plant in that city even without any incentives). However, since these published cases involve public high-stakes interstate bidding wars, it is not unreasonable to assume that the outcomes are perfectly competitive situations which can be attributed 100% to the incentive packages. The costs involved are usually state and local dollars, with very little federal leveraging. With the exception of the 1984 Nissan plant, all of these job-costs are drastically higher than KTEC's job-costs.

However, job costs from bidding wars are not a very suitable comparison for KTEC because the standard is much too easy to meet.<sup>35</sup> Other kinds of economic development agencies have been shown

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<sup>35</sup> One might predict that these bidding wars will prove to be a temporary and self-limiting phenomenon, because the costs involved in even moderately competitive cases have become utterly unreasonable. To estimate one extreme upper bound for the social value of a net job that lasts forever, consider that if one put around \$400,000 into a stock market index fund and smoothed out the resulting income stream by borrowing, then one would have roughly enough income in perpetuity to pay one average manufacturing worker to stay home and simply forget about getting a job. Of course, it would be even better to hire the worker to help maintain public green spaces or construct public amenities. This implies that the social value of a net job that lasts forever is at most \$400,000, less the present value of the public amenities that the worker could produce. Since real jobs do not last forever, the social value of a real job should be even less. With all things considered, \$300,000 is an overly generous upper bound on the social value of a *gross* job, in the absence of opportunity costs.

However, the most important limit on the social value of a job is the opportunity cost as defined previously (i.e. the jobs foregone by not handing the dollars directly over to Kansas taxpayers). Under the assumptions used above, that implies an upper bound social value of only \$85,000 per *gross* job. Any projects with a cost per gross job that exceeds \$85,000 will be counterproductive (at least with respect to producing jobs) In other words, as the cost per gross jobs approaches that figure (e.g. \$85,000), the cost per net job (which is what we really care about) approaches infinity.



to be much more productive than “smokestack chasing” or bidding wars. But fewer data are available on job costs in these programs.

*Incubators may lead to very high job-costs, at least from the state point-of-view*

One very carefully documented study describes a business incubator in an unidentified metropolitan area of 117,000 people. The incubator cost about \$6,580 per direct job-year associated with the incubator, and about \$4,460 per direct plus indirect job-years [Markley and McNamara, 1995a]. The survey upon which these results were based found that, in the absence of the incubator, *nearly all client firms would have started up anyway*, but about 30% of firms would have started up in another city. That implies that the costs of jobs actually caused *in the target city* may be around \$22,000 per gross direct job-year. However, almost 2/3 of the funds were leveraged federal funds, so that state plus local costs per gross direct job-year were around \$7,000. Also, the jobs were discounted over time and restricted to job-years realized in the past (similarly to the ROPI model). Converting from discounted job-years into units of jobs assumed to last forever would imply a standardized cost per gross direct job of around \$28,000.

This last calculation focuses, however, on jobs created *in the same city*. In the absence of the incubator, 70% of those jobs would still have been created in the same city, and 30% of those jobs would have been created in some other city, often in the same state. If we assume that 2/3 of those out-of-city jobs would have remained in the same state, then the cost per gross *statewide* job would be around \$84,000. After correcting for opportunity cost, the cost per net state-wide job would be millions of dollars, or more likely the agency would actually be found to be counterproductive from the point of view of the state as a whole. In other words, the agency was very effective at moving jobs from one city to another; but it was quite possible that the opportunity costs of the agency destroyed more jobs in the state as a whole than the agency created.<sup>36</sup>

Another incubator is briefly mentioned by Markley and McNamara [1995b]. In Hutchinson, KS, 50 jobs were created over seven years at a cost of \$8,400 per job. That figure is somewhat similar to those given in Markley and McNamara [1995a], which suggests that a detailed analysis like that given above would lead to similar conclusions.

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Also, of course, a particular jurisdiction could quite reasonably reach the political value judgment that it was unwilling to spend *anything* to create or retain jobs. By definition, in such a jurisdiction the social value of a job would be zero.

<sup>36</sup> This does not necessarily imply that incubator programs are unjustified, even at the state level. Even if incubators don't provide jobs at the state level, they *do* provide a useful service to start-up firms—a service that private markets had previously failed to provide. It may be possible to privatize many incubators, now that the concept has been proven by means of government intervention. But even if incubators cannot be privatized, they might still pass a benefit-cost test, because they might overcome specific market inefficiencies that result from transactions costs. That is, they may help reduce the social cost of startups.

In other words, incubators seem likely to have moderately high true costs per job created in the city, and extremely high true costs per job created in the state. The preponderance of evidence is that incubator jobs at the state level are likely at best to be much more costly than KTEC jobs, and at worst counterproductive.

### **A few benefit-cost ratios have been measured for technology transfer in other states**

*Several state-level studies appear to have comparable income BCRs to KTEC*

A few studies have calculated traditional benefit-cost ratios for state-level economic development programs using a state-benefits point of view. Their benefit-cost ratios were calculated solely in terms of generalized income. As such, they correspond approximately to the ROPI BCR for personal income. As described above, we found that KTEC's BCR for personal income in Kansas had a lower bound of about 3. Feller and Anderson [1994] found a lower bound BCR of 3 and a preferred state-level BCR of 6 for the New York State Centers for Advanced Technology. Assuming a 10% discount rate, Samaza [1970] found BCRs for state development loan agencies of between 4.7 and 12 for Pennsylvania, and between 1.2 and 4.9 for agencies in New York, Rhode Island, Maine, and Connecticut.

Just as in job-cost studies, outcomes of these benefit-cost studies are highly sensitive to a number of methodological decisions. In a few respects, all of the reviewed studies were similar:

- “Standing” (also referred to as the problem of interstate “spillovers” or the “open economy framework”). The studies focused on the self-interest of a single state, so benefits and costs to persons and businesses in other states are ignored.
- U.S. government costs. These were ignored for the same reasons.
- Attribution. The studies surveyed or interviewed firms to estimate the share of responsibility that the agency could claim for the observed outcomes.
- Private-sector costs. Investment costs borne by firms inside the state were not viewed as costs to the state.

In other respects, there were substantial differences across the studies. Some of the more important differences include:

- Discount rate. The New York study used a discount rate of 0% for the first three years, and then a 100% discount factor. The development loans study used various discount rates, with 10% in real terms being the highest. The KTEC BCR used a real discount rate of 12%. Higher discount rates lead to lower BCRs.
- Future benefits. The development loans study included all benefits predicted for the future. The New York and Pennsylvania studies both included selected future benefits, or their proxies, for

three years. The KTEC BCR omits all future benefits, which tend to lower the BCR. However, the ROPI study also surveyed a larger number of past years, which tends to increase the BCR.

- Treatment of sample non-responders. The development loans study assumed that non-responders were similar to responders; that assumption alone roughly doubled the BCRs. The New York study was not sensitive to sample responses, since the main reliance was on administrative records. The KTEC BCR omitted benefits (but not costs) received by non-responders, leading to a lower BCR.
- Data quality. The New York study relied mainly on first party administrative records rather than third party surveys, which may lead to overstated BCRs. However, in some cases detailed interviews were conducted on the question of attribution.
- Multipliers. Neither the development loans study nor the New York study used impact multipliers. The KTEC BCR used multipliers on both benefits and costs, which could move the BCRs in either direction.

There are many other differences among the studies which we judged to be less important. These include:

- Leveraging model for federal funds. The New York study assumed that only 20% to 40% of federal research dollars received were actually attracted by the technology agency *per se*. The KTEC BCR assumed that federal dollars were leveraged in proportion to KTEC's share of the base funding. This generally led to a higher leveraging ratio and a higher BCR for KTEC
- Leveraging model for out-of-state private investment funds. The New York study assumed that between 50% and 90% of out-of-state investment dollars received were actually attracted by the technology agency *per se*. The KTEC BCR assumed that out-of-state investment dollars were leveraged in proportion to the attribution rates reported by the surveyed firms.<sup>37</sup> This generally led to a lower leveraging ratio and a lower BCR for KTEC.
- Types of benefits included. Some 10% of benefits in the New York study consisted in the value of education provided to the work force; those values were not included in the KTEC BCRs.
- Many other detailed modeling assumptions.

We are unable to make precise adjustments for these differences because much of the needed data are simply not available. However, we can make some educated guesses.

Development loans: two important adjustments would make the development loan BCRs more comparable to the KTEC results. First, adjusting for sample non-responders would lower the development loan BCRs by around 50%. Second, adjusting the real discount rate from 10% to 12% would probably lower the BCRs by another 20%. On net, this would reduce the Pennsylvania BCR to between 2 and 5, and BCRs for the other states to between .5 and 2. This would make the KTEC BCR comparable to the Pennsylvania result, and substantially better than the BCRs for other states.

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<sup>37</sup> In-state investment dollars were treated the same way.

We are not able to adjust for use of future benefits, but we believe that doing so would then make the over-all comparison favorable to KTEC (and also to the New York agency, as well as the Georgia agency discussed below).<sup>38</sup>

New York: other studies have shown that use of administrative records instead of third party surveys leads to an upward bias on BCRs, but the size of this bias is subject to extreme variation across agencies. Our best guess is that adjustments for all other factors together would be less important on net than this bias (which is aggravated by the fact that the lower bound ROPI measure excludes benefits to non-responders). Adjusting for this bias could make the preferred New York BCR roughly comparable to the lower bound KTEC BCR.

*A nationally-oriented state-level study suggests a high ROPI*

Shapira and Youtie [1995] found a BCR for the US as a whole of between 1.2 and 2.7 for the Georgia Manufacturing Extension Alliance. This study is interesting because it contains much of the information needed to calculate a BCR from the Georgia point of view under assumptions somewhat comparable to the KTEC study. We did so and found a ROPI-style state-level income BCR between 8 and 22. The adjustments addressed the following issues:

- The Georgia study included investment costs and federal expenditures in the denominator. (Excluding these costs turned out to be the most important single adjustment.)<sup>39</sup>
- The Georgia study used a nominal discount rate of 11%, versus real discount rate of 12% in the Kansas study (roughly 17% in nominal terms).
- The Georgia study assumed that non-responders were similar to responders.
- The Georgia BCRs used multipliers on tax revenue benefits but not on costs, leading to a higher BCR.

The Georgia study included benefits anticipated by survey responders for three years into the future. The study assumed that these future returns dropped by 25% per year for three years. The KTEC BCR omits all future benefits, which tend to lower the BCR; we are not able to adjust for this difference. There is evidence that survey reports on future benefits are typically much higher than later retrospective reports. This occurs for two reasons: first, business investors tend to be over-optimistic about future returns, once the investment is committed; second, responders tend over time to downplay or forget the importance of the help they received from the economic development agency. On net, the Georgia results appear comparable to what KTEC results would be if future benefits were

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<sup>38</sup> Note that we are *not* saying the development loans study is wrong, but only that it measured a less conservative concept. If KTEC's BCR were measured using the same concept, it would be similarly high.

<sup>39</sup> Empirically, our approach assumes that private R&D investment is mainly withdrawn from a national pool of savings and investment; the Georgia approach assumes that private R&D investment is mainly withdrawn from in-state consumption. Very little evidence is available on this question.

included. Burress and Oslund [1994] did in fact find comparably high or higher BCRs for KTEC when including anticipated future benefits.

**Tax expenditures in Kansas are partly an economic development tool, and as such can be compared with KTEC**

Another way to make an absolute judgment about KTEC as a whole would be to examine the overall consistency of Kansas state economic development policy, including taxation policy. The core economic development tool in Kansas has never been its specific economic development agencies; rather, it consists in various provisions of the tax code. The income tax, property tax, and sales tax include numerous exemptions, deductions, exclusions, and credits, many of which have been justified in terms of effects on the location or output of various industries. Under the same rubric there have been several adjustments in the levels of business-related tax rates. In most sessions of the Kansas legislature, the time spent debating the tax code far exceeds the time spent on all other economic development initiatives combined. Not all of the taxation debate revolves around industrial location, but industrial location and investment has always been an important theme. One important input to the debate has been a model of effects of taxes on industrial location, most recently employed in Oslund and Fetisova [1998]. Also see for example Schwaller and Burress [1990] for an analysis of the economic development underpinnings of existing Kansas sales tax exemptions related to transportation. In this environment, the most important question about KTEC for policy makers may be: has KTEC been at least as effective as a “typical” tax exemption?

*The size of tax expenditures for Kansas economic development has been very large*

Unfortunately, there have been no benefit-cost studies of state-level tax exemption devices *per se*. However, we do have some limited information on the overall *size* of the tax expenditures (i.e., forgone revenues) that result from some of these exemptions. Kansas, Inc. [1998] reports on six specific programs including a sales tax exemption for enterprise zones, and income tax credits related to job creation, workplace training, investment, venture capital, and R&D. These programs led to an aggregate tax expenditure of \$15M in 1996. However, these programs constitute only a tiny share of all Kansas tax exemption devices and of the resulting tax expenditures.

In the area of sales taxes alone, most services are explicitly excluded from Kansas taxation, and there are many additional exemptions explicitly stated in Kansas law. Other sales tax exclusions are implicit in the law but are not explicitly stated; Newberry and Smith [1987] gave some 40 examples (but not an exhaustive list). Kansas Department of Revenue [1990] identified over 60 exclusions and exemptions totaling between \$3B and \$4B in forgone sales tax revenues. That amount is extremely large; it implies an excluded tax base that may exceed the entire state product of Kansas. Therefore, its exact significance requires some explanation.

- This estimate is a merely total of many smaller items; it does not refer to an actual amount that could be collected simultaneously. Each of the smaller items assumes that it is the *only* change being made in the Kansas taxation. (E.g., if an attempt were made to withdraw the whole sum from the Kansas economy at once, then the economy would shrink and reduce the available tax base.)
- However, this amount probably *is* a useful estimate of the amount of dollars that would be available for lowering the sales tax *rate* if all of the excluded items were added to the sales tax *base* (because, in that case, on net no dollars would actually be withdrawn from the Kansas economy).
- Taxing all of the excluded items simultaneously would greatly increase the degree of “double taxation,” especially situations where inputs as well as outputs of business were being taxed. The potential for double taxation explains why the excluded tax base can be so large.
- Avoiding sales taxation of business inputs is a legitimate and important economic development purpose. Yet this concern in and of itself is generally not a decisive factor in determining the Kansas sales tax base. It has been estimated that 45% of the actual Kansas sales tax base consisted in business purchases [Ring, 1989], but this estimate does not take more recent tax law changes into account.

Also, of course, many of these tax exemptions are not specifically targeted at economic development. Roughly speaking, it seems fair to assume that tax exemptions mainly targeted at business expenditures or at sales to non-residents have economic development purposes, and those mainly targeted at household or non-profit expenditures do not.<sup>40</sup> Tax expenditures so restricted are still very substantial.

For example, Table 8.1 shows sales tax expenditure estimates for a selection of items for which the majority of purchases are by businesses or non-residents. The total was about \$320M for FY1991. The idea that these items could feasibly be taxed is not purely hypothetical; about \$210M of the listed tax expenditures (as well as other tax expenditures) actually were proposed for elimination (i.e., inclusion in the tax base) by Governor Finney [Lennen, 1990]. A heated legislative debate ensued,

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<sup>40</sup> Many of these exemptions have been justified in ways that on the surface might appear not to involve economic development. For example, exemptions are sometimes said to be needed to avoid double taxation, or avoid taxation of inputs to production, or avoid inefficient distortion of price ratios. But these purposes have a unifying underlying theme: they seek to maximize real state output, which is also a major goal of economic development.

Business exemptions are sometimes also justified on fairness grounds; however, such arguments often make very little connection with traditional ideas of tax fairness such as horizontal equity, vertical equity, or the principle of benefit taxation. The reason is that traditional equity arguments are generally organized around net outcomes for particular persons, not around outcomes for particular commodities.

In still other cases business-related tax exemptions may have bona fide policy purposes that are unrelated to economic development. For example, taxes on certain commodities or services may be infeasible to collect. Also, some types of taxation are prevented by US constitutional law related to interstate commerce. However, in the opinion of KDOR research staff, these issues were not serious for the tax expenditures listed in Table 8.2.

in which representatives of affected industries stressed economic development issues. These items pale in comparison however with just two business-related exemptions which together incurred over \$1B in estimated forgone sales tax revenues: component parts, and materials used in production.

Many additional exclusions and tax preferences are contained in the Kansas personal and corporate income taxes. However, the personal income tax is mainly focused on households, rather than businesses; while the corporate income tax provides a relatively small share of state and local revenues.

In the area of real property taxation, unpublished estimates by a staff member of the Kansas Department of Revenue in 1990 found that the value of tax exempt real property in Kansas totaled well over \$20B, as compared with taxable real property of \$80B.<sup>41</sup> (Forgone revenues for several important items including aircraft were not estimated.) Much of this property belonged to households, government or non-profit institutions, but over \$6B consisted in hotels, farm machinery and equipment, grain and livestock, and merchants and manufacturers inventory. These business-related exemptions led to forgone revenues of perhaps \$100M, depending on what assessment ratios are assumed.<sup>42</sup>

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<sup>41</sup> Presentation to the Governor's Tax Policy Transition Team, December 1990.

<sup>42</sup> A much larger exemption derives from the exclusion of intangible or financial property. Historically, the Kansas Constitution did provide for taxation of intangible property, and there is still a remnant intangibles tax in some municipalities. The reasons for this shift in Kansas as well as most other states appear related partly to economic development, and partly to problems in compliance and administration.

**Table 8.1**  
**Selected Kansas Sales Tax Expenditures, FY1991**

Statutory reference (KSA)	Item description	Estimated forgone revenue (FY1991)
79-3603(p)	major construction services	\$86M
79-3606(f)	property purchased by interstate carriers	\$20M
79-3606(k)	motor vehicle, trailer, aircraft sold to non-resident	\$30M
79-3606(u)	farm machinery	\$32M
79-3606(mm)	manufacturer's machinery and equipment	\$42M
79-3602(e)	legal services	\$25M
79-3602(e)	engineering, architectural, surveying services	\$14M
79-3602(e)	accounting, auditing, bookkeeping services	\$11M
79-3602(e)	public relations, management consulting	\$29M
79-3602(e)	security services	\$15M
79-3602(e)	temporary help agencies	\$15M
	Total	\$319M
Notes: does not include purchases by non-profits. Where a range was given in original sources, the lower bound is used. Local sales tax revenues are excluded.		
Sources: KDOR estimates; Lennen [1990].		

Looking only at the Kansas tax expenditures identified above, total tax expenditures of all types exceed a tenth of the gross state product. Of this total, business-related sales tax expenditures for component parts, materials used in production, and items listed in Table 8.1, totaled around \$1.5B in FY1991, equal to more than 3% of state product. This strikingly large sum is many times as large as the budgets for KTEC and all other direct Kansas economic development programs combined.

In our opinion, very good economic development arguments can in fact be made for each of the tax exemptions discussed above (and other types of arguments can be made as well). The question at issue here is purely a comparative one: what is the relative effectiveness of these various tax expenditures in comparison with other economic development programs?



*National evidence suggests that tax expenditures are modestly effective for economic development*

The effects of aggregate state and local taxation on investment and business location have been studied extensively, though generally not within a benefit-cost framework. Until about fifteen years ago, the main conclusion from the empirical literature was that state-level taxes have very little appreciable effect on the location of aggregate totals of business. Local taxes, however, were found to affect choice of business location among competing suburbs within the same metropolitan area. More recently, more detailed studies have been able to document some locational effects at the state and intermetropolitan level as well. Bartik's [1991] estimate from review of the literature is that tax elasticities of industrial activity may be in the neighborhood of -.3, meaning that a 10% decrease in the overall tax burden on industry leads to a 3% increase in industrial activity. Wasylenko's [1997] review suggested an elasticity of -.2. For purposes of interpretation, we will assume these elasticities apply under the following conditions:<sup>43</sup>

- all other taxes and government services are held constant<sup>44</sup>
- the tax burden is that on “export base” industries, i.e., industries such as manufacturing that bring in dollars from outside the state
- industrial activity is measured in terms of sales or payroll
- multiplier effects are included in the income increase, but not in the tax burden decrease
- full future benefits of any tax reduction are included in the elasticity, but only over a limited time horizon
- elasticities apply to average tax burdens per sales of firms (not marginal tax rates)
- hence elasticities apply to tax expenditures as well as to aggregate taxes
- the elasticity does not change with relative size of the tax burden.

To translate this elasticity into a crude benefit-cost ratio, we can simply change the sign and multiply by the ratio of industrial wages and salaries to business taxes.<sup>45</sup> Data in the model used by Oslund [1998] show that this ratio has ranged between 5 and 17 for various export base industries in Kansas. Therefore, elasticities of -.2. to -.3 imply a crude BCR between 1 and 5, with a most likely value around 3.

However, to make this result comparable to KTEC's BCR, we would need to make at least three additional adjustments:

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<sup>43</sup> We believe these assumptions are roughly consistent with the studies Bartik and Wasylenko reviewed.

<sup>44</sup> This assumption implies that neither opportunity costs nor multiplier effects of taxes have been accounted for.

<sup>45</sup> Because the elasticity is defined as  $\epsilon = (\Delta\text{payroll}/\text{payroll})/(\Delta\text{taxes}/\text{taxes})$ , we have as an approximation:  $\text{BCR} = -\Delta\text{payroll}/\Delta\text{taxes} = -\epsilon(\text{payroll}/\text{taxes})$ .

- deduct the multiplier effects of taxes (correctly accounted for in the KTEC BCR but not in the BCR estimated above)
- deduct benefits corresponding to those received by survey non-responders (not included in the KTEC BCR)
- deduct for benefits corresponding to future benefits (also not included in the KTEC BCR).

Correcting for multiplier effects using a multiplier of 1.5 would lower the taxation BCRs to between .7 and 3.5, with a most likely value of 2. Correcting for future benefits and survey non-response is much harder. If we are willing to base the correction on *anticipated* future benefits and assume that survey non-respondents are basically similar to respondents, then data from Burrell and Oslund [1994] would lead to a correction ratio for benefits of nearly 8 to 1. This would lead to an adjusted BCR for tax expenditures of between .1 and .4. However, this correction is surely much too large: survey respondents tend to overestimate future benefits, and survey non-respondents tend to be less successful than survey respondents. We are left with the conclusion that a comparable BCR for tax exemptions is somewhere in an uncomfortably wide range between .1 and 3.5, with a most likely value of well under 2. In other words, it could be either less than or greater than the comparable KTEC BCR of 3, but is highly likely to be less.<sup>46</sup>

*KTEC is probably at least as effective as a typical tax expenditure*

Let us focus now on just the sales tax expenditures for component parts, materials used in production, and items listed in Table 8.2; and let us assume, for sake of argument, that these tax expenditures are at least equally as effective as KTEC in a benefit-cost sense. Then using a lower bound BCR of 3 and assuming that these tax expenditures are at least 3.3% of state income, these exemptions would have to be expanding total personal income in Kansas by at least 10%. In 1994 this would have amounted to some \$5B. The implication is this: policy-makers who believe these listed tax expenditures are responsible for producing Kansas outcomes that are worth less than 10% of state income, should (if all other policy considerations were ignored) support a shift away from tax expenditures and towards more reliance on programs like KTEC.<sup>47</sup>

In a political sense, tax expenditures are not fully comparable with direct budgetary expenditures. However, in an economic sense they are indistinguishable. In particular, replacing a direct subsidy

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<sup>46</sup> An additional correction is needed for the share of the tax expenditure that is targeted to households rather than to businesses. For a typical tax expenditure, that share is something like 50%. Therefore the typical BCR would fall into a range of .05 to 1.8, which is to say it is much lower than KTEC's lower bound BCR of 3.

<sup>47</sup> A point which strengthens this argument has to do with differences in effectiveness between different tax exemption devices. The previous arguments suggest that tax exemptions of *average* effectiveness may be less effective than KTEC at economic development. Therefore, the *least* effective tax exemptions are likely to be much less effective than KTEC. Therefore, it would be economically rational to try to identify the least effective tax exemptions, eliminate them, and shift the additional revenues to KTEC.

program with a tax exemption program involving equal amounts of money with equally effective administration has absolutely no important economic consequences.

Clearly, this discussion has omitted quite a number of important political considerations. In other words, economic development may not be the sole reason for granting a given tax exemption, not even when it is the sole *stated* reason. However, the same could also be said for other economic development programs, including KTEC. As one dimension of a multi-dimensional policy analysis, it is reasonable to compare the relative effectiveness of tax expenditures and KTEC expenditures purely in terms of economic development outcomes. Such a comparison does not resolve the overall social or political values of the given programs, but it does resolve their relative *economic development* values. The evidence strongly suggests that KTEC is at least as effective at economic development as a typical business-related tax expenditure in Kansas.

**Conclusion: KTEC is at least comparable to other programs, and superior to many**

Data from a variety of sources suggest the conclusion that KTEC outcomes are at least competitive with, and in many cases are superior to, the outcomes of other state-level economic development programs that have been evaluated.

It is noteworthy that programs among those under review that are comparable to KTEC in measured quality, tend to be technology transfer programs; as such, they are relatively similar to KTEC in design and implementation. This finding tends to substantiate the general results we found for KTEC, in the sense that other studies of similar programs have found similarly high BCRs.

## 9. CONCLUSIONS

Evaluation studies have various possible goals. Among these are:

- Program justification. In other words, can expenditures on KTEC agencies be justified by the outcomes they have produced?
- Project and program selection. In other words, can KTEC improve its mix of programs?
- Process improvement. In other words, can KTEC improve its administrative procedures?

This report evaluates KTEC outcomes, rather the particular administrative processes it follows. As such, the basic question addressed is one of program justification for KTEC as a whole, and also for its component agencies. Much of the information in this report could also be useful in helping KTEC revise its mix of programs. The information could be tangentially useful in helping KTEC improve its internal procedures.

### **KTEC as a whole is a strong program**

These data show that KTEC has been productive on net in terms of every measured indicator of successful outcomes. All benefit-cost ratios (BCRs) are significantly larger than 1, and all cost-effectiveness ratios are positive. In other words, KTEC does produce significant outcomes of the types it was designed to produce. In at least that minimal sense, the KTEC program as a whole, as well as each of its particular agencies studied here, are justified by their outcomes.

To get beyond that, one must answer the question of whether these measured rates of productivity are “high enough” to justify the program. But that essentially requires a political rather than an economic judgment.

Comparisons with studies of other economic development programs can, of course, be very helpful in making that judgment. In particular, if other types of programs in Kansas were more productive of desired outcomes than KTEC, then it would be desirable to shift resources away from KTEC and towards those programs. However, the evidence in Chapter 8 suggests the opposite; i.e., KTEC has probably been as productive as, or more productive than, other economic development programs in Kansas.

Also, if similar programs in other states were found to be more productive than KTEC, then one might want to look to methods followed in those other programs to suggest changes in KTEC methods and procedures. But again the evidence tends to indicate the opposite; i.e., KTEC has been comparable in productivity to technology transfer programs in other states.

We are still left with the question of whether KTEC has been “productive enough.” To make the case for KTEC in positive terms by focusing on income BCRs, putting a dollar of Kansas funds into

KTEC has had similar results as if Kansas as a whole paid one dollar out in taxes in order to immediately receive three dollars back in income. But, to point out the negative side of the argument, the Kansas citizens who paid out the dollar in taxes were not always the same individuals as those Kansas citizens who received three dollars back in benefits. That is, benefit-cost ratios are simply not sufficient information to settle all the political issues at stake. Yet they are important and relevant information.

Perhaps the strongest way to make an absolute judgment on the political worth of KTEC as a whole would be to examine it in the context of the overall Kansas state economic development policy. The core economic development tool in Kansas has never been its specific economic development agencies; rather, it consists in various exemptions, deductions, exclusions, and credits in the tax code. To a significant extent these tax expenditures are devoted to economic development goals, though many of them are also devoted to other goals. In Chapter 8 we argue that certain identified sales tax expenditures related to economic development by themselves exceed 3% of state income, and also that tax expenditures are equivalent to direct budgetary expenditures in terms of their economic consequences. If tax expenditures are equally as effective as KTEC expenditures for producing new income in Kansas, then assuming a lower bound BCR of 3, the identified tax expenditures must be producing more than 10% of all Kansas state income. In our opinion, to make such a judgment would be to overstate the economic importance of these particular details of the Kansas state tax code. But if one doubts that 10% of everything good produced in this state results from the identified tax exemptions, then one should also doubt that tax expenditures in Kansas are as effective as KTEC expenditures at producing good things in Kansas. In other words, on a unit cost basis KTEC is likely to be more effective at producing desirable outcomes in Kansas than is a typical existing tax exemption, deduction, exclusion, or credit in the Kansas tax code.

### **Each individual KTEC program is positively productive**

The data show that every individual KTEC agency under review has been positively productive in terms of every measured indicator of success.

However, the individual agencies differed greatly in their measured rates of productivity. The amount of variation depends sensitively on the particular indicator chosen. In the most extreme example of this, benefit-cost ratios for manufacturing start-ups ranged from 1.8 to 216. Even in the least extreme case, the BCRs for personal income ranged from 1.1 to 7.7.

Moreover, the ranking among agencies is highly sensitive to the chosen indicator of success. For example, Ad Astra was the least successful agency with respect to several indicators, but it was the best with respect to manufacturing start-ups. MAMTC was least successful with respect to patents issued, but best with respect to leveraged federal funds as well as some of the weighted aggregate indicators (including the overall weighted total). ARMF was best with respect both to patents and to private manufacturing investment, but generally in the middle of the pack on the other indicators.

NIAR was at the top with respect to several indicators, but below average on patents and manufacturing start-ups. Higuchi was the least successful agency with respect to private manufacturing investment, but above the median on most other indicators. Only three of the eight agencies were ranked with some consistency across indicators: CDDP tended to be at or near the bottom of the pack on most indicators; CECASE tended to be near or just below the middle; and AMI tended to be a little better than CDDP but a little worse than CECASE.

For the other programs, any effort to form a ranking must depend on additional political judgments. We simply have to decide in a political sense what outcomes are most important, and then identify the “good” agencies as the ones that were best at producing those outcomes.

Burress and Oslund [1994] proposed a way to select a set of political judgments for ranking the various programs. In that study, a “blue ribbon” panel of Kansas citizens was educated on the general strategies and purposes of KTEC programs and then asked to form weights for the relative importance of the different goals and indicators. A set of weights was interpreted from each panel member's responses using a formal procedure, and then the weights were averaged. The BCR measure obtained using these average weights is reported along with the other BCRs in Table 6.3. According to this weighted measure, the best agencies over-all were MAMTC and NIAR, with weighted BCRs above 20; the least successful agency was CDDP, with a weighted BCR of about 3. AMI had a weighted BCR of about 8; the other agencies have weighted BCRs that are closely grouped, ranging between 10 and 14.<sup>48</sup>

These results, viewed apart from any other information, seem to argue for shifting some funds away from CDDP, and perhaps also from AMI, and towards the other programs. There are several reasons to think that conclusion is too strong.

First, there have been very substantial shifts in measured rankings of agencies between the previous ROPI report and this study. In the most extreme case, CDDP fell from first place to last place with respect to several indicators. (This kind of shift is possible because the two studies used entirely independent survey data sets. In particular, the firms with the most successful single project on the first survey did not respond to the second survey.) We can predict that there will be additional shifts in any future studies. Agencies that received a relatively low ranking in this report, may receive a higher ranking on the future; and vice versa. Therefore, based on ROPI data alone, it would be premature to cut back a given program, unless there has been a consistent showing of significantly below-average performance over time.

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<sup>48</sup> Note, however, that individual panel members had preferred weights that differed from the average, and using one or another set of the individual weights would lead to significant changes in the relative rankings of programs.

It is equally important to note that each KTEC agency tends to concentrate on a different region of the state and emphasizes different industries. To some extent, each agency focuses on different types of outcomes. Therefore, differences in outcomes of agencies may depend more on differences in the economic fortunes of various regions and industries, or on differences in the immediate objectives of the program, than on the quality of administration of the programs. Moreover, there are significant policy reasons for Kansas to keep supporting this kind of diversified portfolio of regions and industries.

For example, if Kansas avoids “putting all its eggs in one basket,” then the Kansas economy as a whole will be less sensitive to national trends that are adverse to one or another particular industry. Having diversified KTEC agencies is a step toward having a diversified industrial base.

In addition, many citizens feel that, as a matter of geographical fairness, Kansas state government has an obligation to spread its economic development efforts widely across the state. Some KTEC programs, especially ARMF and MAMTC, do seek to have a widely dispersed impact on the state. But most KTEC agencies tend to serve one particular region of the state, due to the obvious advantages that result from physical proximity. Each Center of Excellence agency is associated with a particular university campus, and has more of a presence near that campus than elsewhere. Some agencies are associated with particular industries, and firms in the same industry tend to cluster near each other (e.g., aircraft in Wichita; e.g., computer programming in Johnson county.)

According to the geographical fairness view, it would be desirable to preserve any agency that meets three tests:

- it tends to serve a particular region of the state
- it is the main technology agency serving that region of the state
- it has reasonably positive technology outcomes (as measured by its BCRs).

If it does meet all three tests, then an agency's funding is well justified, even if its measured BCRs are not as large as those of some other agency in some other part of the state. CDDP in South-Eastern Kansas is one such program.

### **Measurement uncertainty is a major concern in this and any evaluation**

An underlying theme in much of this report has been randomness in measurements and in outcomes. This randomness leads to several types of uncertainties and measurement errors:

- Individual agencies may fare much better or much worse from one time period to another.
- Individual agency outcomes may sometimes depend more heavily on random chance operating in the economy than on administrative skill.
- Agency outcomes are often highly sensitive to one or two big successes.

- Aggregate agency results may be sensitive to the business cycle.
- Agency clients may vary in their willingness to return surveys.
- Agency clients may vary in their propensity to attribute favorable outcomes to KTEC rather than to their own entrepreneurialism.

These uncertainties are of two kinds: errors in the ROPI measurements, and true unpredictability of outcomes.

*Measurement errors have been controlled using the lower bound technique*

No evaluation measurement is error-free. The BCRs in this report are based on surveys and models that are subject to reporting errors. However, the aggregate of these errors probably tends to understate positive benefits but not costs, so that the BCRs reported above are conservative. Most importantly, benefits achieved by firms that failed to respond to the surveys were simply ignored, while the costs that were incurred on their behalf are still included.

We do not know the average amount or direction of non-sampling errors. Most importantly, we do not have an independent firm-by-firm check on the degree of attribution that each firm assigned to KTEC for causing its success. We do know, however, that the general trend of those attributions is entirely consistent with an independent econometric study of effects of KTEC on the growth and survival of firms (see Chapter 7). Thus there is no evidence that attribution errors tended to cause an overstatement of the BCRs reported in this study.

Therefore, we are confident of our finding that KTEC as a whole has a realized income BCR of at least 3—i.e., it has already achieved income benefits of at least three times the opportunity cost of the program—and that an income BCR that included future benefits would be substantially higher. We are also confident that KTEC-wide BCRs, when denominated in terms of other indicators such as jobs, patents, and business startups, are higher yet. We are similarly confident that BCRs for the individual KTEC agencies are at least as high as they are reported to be above.

There is a sense in which we are less confident of the *rankings* we observed among the individual KTEC programs. These rankings could well have been changed by the addition of information on firms that did not respond to our survey. We suggested in Chapter 5 that it is legitimate to take survey response itself as a basis of evaluation; that is, one test of an agency is its ability to motivate its clients to respond to evaluation surveys. But policy-makers and administrators might reasonably take the opposite view. If so, then they would have an additional reason to give the benefit of the doubt to the lower-ranked programs.



*Outcome uncertainties are innate to the process of technology investment*

Much of our uncertainty about the true effectiveness of KTEC has nothing to do either with KTEC itself or with the ROPI method. Instead, much uncertainty is innate to the process of making private market investments, and especially to the making of investments in R&D and technology marketing. Recent research has emphasized the extremely risky nature of individual R&D investments.<sup>49</sup> In general, an overwhelming majority of R&D investments in all countries and all times fail to lead to marketable goods or processes; the majority of newly marketed technology-related goods fail to return a profit; and the majority of new initial public stock offerings (IPOs) for currently successful technology businesses do not hold on to their initial value. Nevertheless, *average* (private) returns received by technology investors are high (and higher in fact than returns to most other kinds of investments), because a small share of investments do receive exceedingly high returns.<sup>50</sup> Unfortunately, there is no known way to predict in advance exactly which technology investments will fall into that elite group of successes. Most technology investors have already made the best predictions they can make; otherwise, they wouldn't have risked their money; and ordinarily administrators cannot improve on their predictions.

Because of this irreducibly high degree of riskiness, many would-be technology investors are unable to obtain sufficient amounts of risk capital, and therefore many proposed investments do not get made at all. Some of these unfunded investments were simply bad ideas. Others, however, would have been good bets from the point of view of society as a whole, even though they didn't appear to make economic sense for any individual backer. In other words, the extreme riskiness of technology investments leads to a market failure.<sup>51</sup>

KTEC was designed to manage these outcome uncertainties. First, the fundamental purpose of KTEC is to encourage socially beneficial technology investments that would not otherwise occur. To the extent that it accomplishes this goal, it overcomes riskiness as a barrier to private investment. The evidence on attribution indicates that, to a substantial extent, KTEC has been successfully accomplishing this goal.

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<sup>49</sup> Scherer [1997]; Harhoff, Scherer, and Vopel [1997]. The problem is not merely a high variance but also an extreme degree of skewness in returns to R&D investments. That means that extremely large investment portfolios would be needed in order to successfully diversify against risk.

<sup>50</sup> Moreover, *social* returns to investment can be twice as high as private returns, meaning that half of the returns were received as spillovers to individuals who were not at risk (Mansfield, [1991]). This kind of spillover is an important reason why technology programs like KTEC can be especially beneficial to the public. Comparable spillovers do not occur for most other kinds of investment.

<sup>51</sup> In other words, because the social portfolio is much broader than any individual portfolio, risks that are adequately diversified from the point of view of society as a whole, may not be adequately diversified from the point of view of any individual investor.

Second, KTEC has to manage the riskiness inherent in its own activities. That is, KTEC has to achieve some degree of continuous and ongoing success in order to maintain the political support it needs to keep operating. Therefore, KTEC cannot afford to put “all of its eggs in one basket” by investing in a single project, no matter how good its prospects might appear be. It is in the nature of technology investments that most projects fail; therefore a “one egg” KTEC would be more than likely to fail. The only way that KTEC can reduce this kind of risk is by investing in a large portfolio of projects, preferably covering many different and unrelated industries. KTEC has accomplished this goal as well.

However, one must keep in mind that Kansas R&D constitutes only a tiny fraction of the technology investment universe. As a result of this fact, coupled with the extreme innate riskiness of technology investment, there simply is no way that KTEC can diversify its investments sufficiently to remove substantially all randomness from its aggregate outcomes. Even given the best administration in the world, a technology development agency like KTEC could hit an initial run of bad luck, and indeed out of sheer bad luck might never produce a successful portfolio.<sup>52</sup> The same principle applies to an even greater degree for any of the individual agencies within KTEC.

That consideration puts policy-makers and others who evaluate technology programs into a dilemma. On the one hand, evaluators can't necessarily make too much out of any one observed agency failure, because it may reflect mere blind chance unrelated to the true future worth of the program. On the other hand, there does need to be some firm standard of evaluation; that is, policy-makers do need some way to recognize fundamentally bad agencies so that they can be closed down. For whatever it may be worth, we suggest that the following guidelines should be considered for incorporating formal evaluation data into political decisions:

- Agency managers in conjunction with policy-makers should set a reasonable time period, within which a given agency should be expected to prove itself.
- “Success” should be defined in terms of aggregate inputs and outputs and aggregate BCRs at the “portfolio level,” not in terms of project success rates or project-level BCRs.
- Political decisions should be made that set numerical levels or goals for BCRs as defining “success.”
- Because they are riskier, technology agencies should be evaluated using a higher degree of aggregation than non-technology programs. In other words, they should be evaluated over a longer time period, or else several agencies should be aggregated together.<sup>53</sup>

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<sup>52</sup> We believe that the converse is not true. That is, we doubt that any economic development agency could achieve real and notable successes without exercising a reasonable degree of administrative skill. There are simply too many ways to waste funds on overhead, or invest in the omnipresent surplus of bad ideas, or invest in “safe” projects that would have taken place even in the absence of the program.

<sup>53</sup> Note that this does *not* mean that standards should be set any lower for technology agencies than for non-technology agencies. It just means the standards cannot be applied to as fine a grain of detail.

- Other considerations being equal, agencies that fail to meet numerical goals persistently over their given time frame should be closed down.
- Other considerations being equal, agencies which achieve occasional successes within their originally given time frame should be viewed as having significant potential and given an opportunity to make administrative improvements.

We do not mean to imply that formal benefit-cost information can or should be the sole or main basis for evaluation. We do believe, however, that high benefit-cost ratios (if the indicators are appropriately selected and the BCRs are conservatively calculated) are very strong evidence that the agency is, in fact, accomplishing its intended goals.

## **APPENDIX 1: SURVEY INSTRUMENTS**

Note: the following shows the questions but not the original typography and layout of the forms. The instruments are in the following order:

1. Typical cover letter (ARMF example)
2. Ad Astra mail instrument
3. ARMF mail instrument
4. Typical telephone follow-up (ARMF example)
5. Typical Center of Excellence mail instrument (Higuchi example)
6. MAMTC mail instrument

May 7, 1996

«salutation» «First-name» «last-name» «suffix»  
«Company»  
«address 1»  
«address 2»  
«city», «state» «zip»

Dear «salutation» «last-name»:

The purpose of this letter is to ask your help in evaluating the economic impacts of KTEC programs.

As a client of the Applied Research Matching Fund, you have been the beneficiary of assistance from KTEC funds. Now we are asking for your assistance in return. In particular, we are asking that you fill out the attached questionnaire. Based on the experience of previous respondents, it should take about 20 minutes of your time. We are asking for information based on your memory or best estimates; we are *not* asking for a detailed search of your business data base.

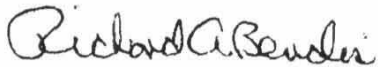
This questionnaire is part of an innovative project sponsored by KTEC called "ROPI," which stands for "Return on Public Investment." The ROPI project is looking at the economic impacts of all KTEC programs on the state of Kansas. Public funding supports these programs, and policy-makers are interested in the program outcomes. Your responses to the questionnaire will provide important information about the usefulness of the Applied Research Matching Fund program to the state of Kansas.

I realize that some of the questions are similar to questions you may have answered previously for the ARMF tracking system. However, the format and details are different. The purpose of this new questionnaire is to establish a benchmark of historical information which is comparable across all KTEC programs.

All responses will be kept strictly confidential. Kansas Law (KSA 74-1804(26C)) states that proprietary business information provided for KTEC purposes is *not* a public record. As you can see, the questionnaires will be returned directly to the Institute for Public Policy and Business Research at KU, which is conducting the study for KTEC. Survey results will be published in summary form only, so that no firm-specific information will be identifiable.

Thank you very much for your assistance in this matter.

Sincerely,



Richard Bendis  
KTEC President

## Survey of Firms that have received Ad Astra Funding

### SECTION I: IDENTIFICATION OF FIRM

1. Firm name: preprinted field  
 Firm Phone: preprinted field  
 Firm address: preprinted field
- Contact Name: preprinted field  
 Contact Title: preprinted field

### SECTION II: INFORMATION SUPPLIED BY THE FIRM

This survey concerns outcomes of firms that received Ad Astra funding.

1. Please list the approximate dates and amount of investment funding from all sources other than Ad Astra (except in-kind investment):
2. Please list the value of any in-kind investments (e.g., the entrepreneur's unpaid labor and use of facilities):
3. Please list the number and estimated market value of outstanding stock shares.

	Common Stock	Preferred Stock
Estimated market value of 1 share		
Company's total number of shares		

### Firm Characteristics

4. Number of years that your firm has been in business:
5. What is the current total number of employees working for your firm at all locations?
6. What is the current total number of employees working for your firm in the state of Kansas?
7. If Ad Astra funding had not been available to your firm, what would you have most likely done as your next best alternative?  
 (Please Select One Item)
  - 1 would have forgone making investment
  - 2 would have used additional private and/or public funding from other Kansas sources
  - 3 would have used additional private and/or public out-of-state funding
  - 4 would have used a combination of the above sources
  - 5 other (please specify)

**Economic Impact on Firm**

8. Has your company produced any patents, copyrights, or other new technologies since receiving Ad Astra funding?

- 1 Q No.
- 2 Q Yes. (If Yes, indicate numeric counts.)
- 3 ...Number of patents issue -
- 4 ...Number of patents filed
- 5 ...Number of new technologies developed
- 6 ...Number of new technologies commercialized
- 7 ...Number of licenses awarded
- 8 ...Number of software copyrights

9. Please estimate the amount of actual or projected employment your firm had or will have in Kansas, and the average wage per employee.  
(Please start with the year during which your firm first received Ad Astra funding.)

		Employment	Average Wage
1	1989 Actual		
2	1990 Actual		
3	1991 Actual		
4	1992 Actual		
6	1993 Actual		
7	1994 Actual		
8	1995 Actual		
9	Projected 1996		
10	Projected 1997		

10. Please estimate the amount of actual and projected sales by your firm  
(Please start with the year during which your firm first received Ad Astra funding.)

		Sales
1	1989 Actual	
2	1990 Actual	
3	1991 Actual	
4	1992 Actual	
5	1993 Actual	
6	1994 Actual	
7	1995 Actual	
8	Projected 1996	
9	Projected 1997	

11. How much has your firm spent, and how much does your firm plan to spend, on physical capital (machinery, buildings, etc.)  
 (Please start with the year during which your firm first received Ad Astra funding.)

		Amount
1	1989 Actual	
2	1990 Actual	
3	1991 Actual	
4	1992 Actual	
5	1993 Actual	
6	1994 Actual	
7	1995 Actual	
8	Projected 1996	
9	Projected 1997	

12. To what extent would you attribute the employment, sales, and other activities listed above as resulting from Ad Astra's funding? Please use a scale of 0 percent through 100 percent with 0 percent indicating that the start-up would certainly have occurred even without Ad Astra funding, and 100 percent indicating that the start-up could not have been undertaken without Ad Astra.  
 (Enter effect as 0 percent through 100 percent.)
13. Do you have any other comments about Ad Astra or about this survey? (use back side of this page if necessary)

We thank you for your assistance.  
 Your responses will be held in strict confidence.



**Economic Impact Survey for Applied Research Matching Fund**  
**June 1996**

**1. FIRM IDENTIFICATION**

Firm Name: «Company»  
 Contact Name: «Salutation» «First-name» «Last-Name» «Suffix»  
 Firm Address: «address1»  
                   «address2»  
                   «city», «state» «zip»  
 Firm Phone:

**2. ARMF GRANT IDENTIFICATION**

GRANT #	GRANT \$

*Please answer the following questions about the project for which you received (an) Applied Research Matching Grant(s) from KTEC.*

**3. DESCRIPTION OF PROJECT**

Please provide of brief non-technical description of the products or processes that were developed making use of the firm's ARMF grant(s).

**4. FIRM CHARACTERISTICS**

- 4.1 How many years has your firm been in business? \_\_\_\_\_
- 4.2 Was your firm a new start-up at the time it received its first ARMF grant? \_\_\_\_\_
- 4.3 What is your firm's SIC code? \_\_\_\_\_

**5. Technological Impact of Project**

Have any patents, new technologies, or new products resulted from the use of the ARMF grant?

- (1) Number of patent applications filed ..... \_\_\_\_\_
- (2) Number of patents issued ..... \_\_\_\_\_
- (3) Number of new technologies developed ..... \_\_\_\_\_
- (4) Number of new technologies commercialized ..... \_\_\_\_\_
- (5) Number of new products developed ..... \_\_\_\_\_

6. What is the total number of employees working for your firm in the state of Kansas? \_\_\_\_\_

7. Please estimate the amount of actual or projected FTE employment created in Kansas as result of the specific project(s) for which your firm used its ARMF grant(s).

(Please start with the year during which the project(s) began.)

(Please list the total FTE employment associated with the project(s) each year, not just the change from the previous year.)

Year	Amount		Year	Amount
1987 Actual			1993 Actual	
1988 Actual			1994 Actual	
1989 Actual			1995 Actual	
1990 Actual			Projected 1996	
1991 Actual			Projected 1997	
1992 Actual			Projected 1998	

8. Approximately how much did your firm spend (or is it planning to spend) on wages and salaries associated with the employment listed in the previous question (# 7 above)?

Year	Amount		Year	Amount
1987 Actual			1993 Actual	
1988 Actual			1994 Actual	
1989 Actual			1995 Actual	
1990 Actual			Projected 1996	
1991 Actual			Projected 1997	
1992 Actual			Projected 1998	

9. Please estimate the amount of actual and projected sales resulting from the specific project(s) for which your firm used its ARMF grant(s).

(Please start with the year during which the project(s) began.)

Year	Amount		Year	Amount
1987 Actual			1993 Actual	
1988 Actual			1994 Actual	
1989 Actual			1995 Actual	
1990 Actual			Projected 1996	
1991 Actual			Projected 1997	
1992 Actual			Projected 1998	

10. How much has your firm spent, and how much does your firm plan to spend, on physical capital (machinery, buildings, etc.) related to the specific project(s) for which your firm used its ARMF grant?

(Please start with the year during which the project(s) began.)

Year	Amount	Year	Amount
1987 Actual		1993 Actual	
1988 Actual		1994 Actual	
1989 Actual		1995 Actual	
1990 Actual		Projected 1996	
1991 Actual		Projected 1997	
1992 Actual		Projected 1998	

11. In addition to your firm's ARMF grant(s) from KTEC, how much money or in-kind resources has your firm invested in the projects for which it received ARMF grants? Include your matching funds in the appropriate categories. Please include all capital invested since the beginning of the project(s)

TYPE of Capital	Dollar Amount
ARMF Grant(s) (see item 1)	
Financial capital contributed by firm owner(s)	
In-kind resources contributed by owner (e.g., unpaid labor or rent-free work space)	
Financial capital contributed by other investors	
Borrowing	
TOTAL CAPITAL INFUSION = sum of above	

12. To what extent would you attribute the employment, sales, and other activities listed above to your ARMF grant(s)? Please use a scale of 0% to 100%, with 0% indicating that the grant played almost no role, and 100% indicating that the activities could not have taken place without the assistance of the ARMF grant.

\_\_\_\_\_ % (enter 0 - 100)

13. Do you have any other comments about the ARMF grant program or this survey?

Thank you. Your replies will be kept strictly confidential.

## Script for ARMF Phone Survey

May, 1996

### *0. background—don't read to client.*

*This survey will examine the economic impacts of the Applied Research Matching Fund (ARMF) program of Kansas Technology Enterprise Corporation (KTEC). The program is several years old, and some of the older projects may be forgotten by the firms involved. Other firms may have moved or may be out of business. The purpose of the phone call is to remind recipients about a mail survey already sent and to locate the best contact person.*

### *1. ID of firm*

IS THIS (name of firm)?

if not:

IS THIS (read phone number)?

if phone incorrect, or clearly a personal line:

THANK YOU VERY MUCH.

if phone and a business:

DO YOU KNOW IF YOUR BUSINESS WAS EVER NAMED (name of firm?)

If yes, continue script.

if no, THANK YOU.

### *2. ID of contact person*

MAY I SPEAK WITH (name of given contact person)?

if unknown or no longer with the firm:

I AM CALLING FROM THE INSTITUTE FOR PUBLIC POLICY AND BUSINESS RESEARCH AT THE UNIVERSITY OF KANSAS. YOUR FIRM PREVIOUSLY RECEIVED A CASH GRANT AND OTHER ASSISTANCE FROM THE STATE OF KANSAS. THE GRANT WAS PROVIDED BY THE KANSAS TECHNOLOGY ENTERPRISE CORPORATION UNDER ITS APPLIED RESEARCH MATCHING GRANT PROGRAM. WHAT PERSON IN YOUR FIRM WOULD BE MOST KNOWLEDGEABLE ABOUT THAT GRANT?

MAY I HAVE (his/her) JOB TITLE?

MAY I HAVE (his/her) TELEPHONE OR EXTENSION?

MAY I SPEAK WITH (name of new contact person)?

### *3. Once you get to the correct person—*

HELLO. MY NAME IS (name). I AM CALLING FROM THE INSTITUTE FOR PUBLIC POLICY AND BUSINESS RESEARCH AT THE UNIVERSITY OF KANSAS. YOUR FIRM PREVIOUSLY RECEIVED A CASH GRANT AND OTHER ASSISTANCE FROM THE STATE OF KANSAS. THE GRANT WAS PROVIDED BY KANSAS TECHNOLOGY ENTERPRISE CORPORATION UNDER ITS APPLIED RESEARCH MATCHING GRANT PROGRAM. ARE YOU KNOWLEDGEABLE ABOUT THAT GRANT?

if not:

CAN YOU SUGGEST SOMEONE ELSE THAT WE MIGHT TALK WITH? (then go through the hello script again if you get hold of the next contact.)

#### *4. receipt of survey*

WE AT THE INSTITUTE RECENTLY SENT YOUR FIRM A SURVEY ON THE ECONOMIC IMPACTS OF THE GRANT THAT YOU RECEIVED. DID YOU RECEIVE THE SURVEY?

#### *5. action items*

##### *5.1 survey not received*

if not survey not received:

MAY I CHECK THAT WE HAVE THE CORRECT ADDRESS?

read the address. note any corrections.

THIS SURVEY IS VERY IMPORTANT TO US BECAUSE IT IS USED TO HELP DETERMINE THE FUTURE OF THE GRANT PROGRAM. I WOULD LIKE TO FAX YOU A NEW COPY OF THE SURVEY. MAY I HAVE YOUR FAX NUMBER?

if no fax number, offer to mail it and check that the address is correct.

THANK YOU VERY MUCH. [end conversation.]

##### *5.2 survey received*

DO YOU STILL HAVE YOUR COPY OF THE SURVEY?

###### *5.2.1 if the survey is lost or discarded*

THIS SURVEY IS VERY IMPORTANT TO US BECAUSE IT IS USED TO HELP DETERMINE THE FUTURE OF THE GRANT PROGRAM. I WOULD LIKE TO FAX YOU A NEW COPY OF THE SURVEY. MAY I HAVE YOUR FAX NUMBER?

if no fax number, offer to mail it and check that the address is correct.

THANK YOU VERY MUCH. [end conversation.]

###### *5.2.2 if the survey is "in the mail":*

THANK YOU VERY MUCH FOR YOUR HELP. [end conversation.]

###### *5.2.3 if contact still has the survey:*

THIS SURVEY IS VERY IMPORTANT TO US BECAUSE IT WILL BE USED TO HELP DETERMINE THE FUTURE OF THE GRANT PROGRAM. WOULD YOU BE ABLE TO COMPLETE THIS SURVEY IN THE NEXT TWO DAYS? (early next week is ok if they say that they will do survey but can't get to it right away)

if contact will complete it:

WHEN IT IS COMPLETED, WOULD YOU BE ABLE TO FAX IT TO US?

if contact will fax it:

OUR FAX NUMBER IS (913)864-5328. PLEASE MAKE SURE THE FAX IS ADDRESSED TO IPPBR.

if contact will mail it:

THERE SHOULD BE A RETURN ENVELOPE WITH THE SURVEY, BUT JUST IN CASE, OUR MAILING ADDRESS IS

David Burress  
IPPBR  
University of Kansas  
607 Blake Hall  
Lawrence, KS 66045

*6. conclude*

THANK YOU VERY MUCH FOR YOUR HELP. [end conversation.]

## Mail Survey of Higuchi Biosciences Center Clients

### Identification of Firm

- .00 Firm name:      Firm Phone:  
Firm address:
- Firm's SIC code:    Project SIC code:  
Contact Name:  
Contact Title:

(Please make corrections in the space provided.)

### Description of Project

- .01 This survey concerns services provided to your firm by HBC.

Please provide a non-technical description of the product(s), services, or processes that were developed or improved making use of HBC's services or facilities.

(Please fill in or make corrections or check to confirm preprinted information.)

- .02 What were the approximate dates during which HBC services or facilities were used?

(Please fill in or make corrections or check to confirm preprinted information.)

1      Beginning Month and Year

2      Ending Month and Year

- .03 What was the total extent of use of HBC services or facilities?

(Please fill in or make corrections or check to confirm preprinted information.)

Hours

- .04 What fees were paid for use of HBC's services or facilities?

(Please fill in or make corrections or check to confirm preprinted information.)

- 1      Direct Fees  
2      Dollar value of payments in kind  
3      Royalties  
4      Profit sharing  
5      License fees  
6      Stock shares (estimated current market value)

- .05 Below is a list of specific services and facilities offered by HBC. For each service or facility provided by HBC, the check indicates whether your firm used it for this project.

(Please fill in or make corrections or check to confirm preprinted information.)

- 1 contract for research
- 2 contract for testing
- 3 consulting
- 4 license of Higuchi product or process
- 5 visiting scientists program
- 6 conferences, workshops, seminars
- 7 other (please specify)

Firm Characteristics

1. Number of years that your firm has been in business:
2. What is the current total number of employees working for your firm at all locations ?
3. What is the current total number of employees working for your firm in the state of Kansas ?

Firm's Use of Services and/or Facilities of the KTEC-supported program HBC.

4. How satisfied was your firm with the HBC services or facilities that your firm actually utilized?  
Please use a scale of 1 (very dissatisfied) through 10 (very satisfied).
5. If the services or facilities of HBC had not been available to your firm, what would you have done as your next best alternative?

(Please Select One Item)

- 1 would have forgone use of services
- 2 would have performed in house
- 3 would have used private firm in Kansas
- 4 would have used public or private out of state
- 5 other (please specify)

Economic Impact on Firm

6. Have any patents, copyrights, or other new technologies resulted from the use of HBC's services or facilities ?

(Please fill in or make corrections or check to confirm preprinted information.)

- 1 No.
- 2 Yes. (If Yes, indicate numeric counts.)
- 3 ...Number of patents issued
- 4 ...Number of patents filed
- 5 ...Number of new technologies developed
- 6 ...Number of new technologies commercialized
- 7 ...Number of licenses awarded
- 8 ...Number of software copyrights



7. What impact have the services and facilities of HBC had on your firm ?  
(Check all that apply.)

- 1 cost saving for existing product or service
- 2 quality improvement for existing product or service
- 3 process improvement
- 4 development of new product
- 5 helping with new firm start-up
- 6 helping firm seek additional financing
- 7 other (please specify)

8. Please estimate the amount of actual or projected employment created in Kansas or retained in Kansas as a result of the specific project(s) for which you used HBC services or facilities.

(Please start with the year during which the project began.)

- 1 1987 Actual
- 2 1988 Actual
- 3 1989 Actual
- 4 1990 Actual
- 5 1991 Actual
- 6 1992 Actual
- 7 1993 Actual
- 8 Actual/Projected 1994
- 9 Projected 1995
- 10 Projected 1996
- 11 Projected 1997

9. Please estimate the amount of actual and projected sales resulting from the specific project(s) for which your firm used HBC's services or facilities.

(Please start with the year during which the project began.)

- 1 1987 Actual
- 2 1988 Actual
- 3 1989 Actual
- 4 1990 Actual
- 5 1991 Actual
- 6 1992 Actual
- 7 1993 Actual
- 8 Actual/Projected 1994
- 9 Projected 1995
- 10 Projected 1996
- 11 Projected 1997

10. This item applies only to firms that checked off "cost saving" in Question 9 above. What are the estimated actual and projected cost savings resulting from the specific project(s) for which your firm used HBC's services or facilities?

(Please start with the year during which the project began.)

- 1 1987 Actual
- 2 1988 Actual
- 3 1989 Actual
- 4 1990 Actual
- 5 1991 Actual
- 6 1992 Actual
- 7 1993 Actual
- 8 Actual/Projected 1994
- 9 Projected 1995
- 10 Projected 1996
- 11 Projected 1997

11. How much has your firm spent, and how much does your firm plan to spend, on physical capital (machinery, buildings, etc.) related to the specific project(s) for which your firm used HBC's services or facilities ?

(Please start with the year during which the project began.)

- 1 1987 Actual
- 2 1988 Actual
- 3 1989 Actual
- 4 1990 Actual
- 5 1991 Actual
- 6 1992 Actual
- 7 1993 Actual
- 8 Actual/Projected 1994
- 9 Projected 1995
- 10 Projected 1996
- 11 Projected 1997

12. To what extent would you attribute the employment, sales, and other activities listed above as resulting from HBC's services or facilities? Please use a scale of 1 through 10 with 1 indicating that HBC had almost no role, and 10 indicating that the activities could not have been undertaken without HBC.

(Enter effect as 1 through 10.)

- 13 We thank you for your assistance.  
Your responses will be held in strict confidence.

Do you have any other comments about HBC or about this survey ?

(Enter comments.)

**MAMTC Survey**

[survey id]

Primary contact person: name:----- Phone number:-----

Plant address: -----

Your company accepted proposal ----- from ----- of MAMTC's ----- office for assistance in -----

Completion date for MAMTC assistance: -----,

Your firm started business in -----,

Your primary SIC is -----.)

Please confirm whether the above information is correct.

correct             incorrect

If any information incorrect, please write in the corrected information.

Are you the contact person that is listed above?

same person         different person

If a different person, please give your name \_\_\_\_\_

What are the current annual sales of your firm \_\_\_\_\_

What is the current total number of employees working for your firm at all locations \_\_\_\_\_

-----  
1. If the services or facilities of MAMTC had not been available to your firm, what would you have done as your next best alternative?

- would have forgone use of services
- would have performed in house
- would have used a private firm in Kansas
- would have used a private or public organization out of state
- other (please specify) \_\_\_\_\_

2. Annual economic impacts.

A. As a result of the project that you undertook with MAMTC, how much have your annual sales from Kansas facilities changed? \_\_\_\_\_

B. As a result of the project that you undertook with MAMTC,

- i. How many jobs have been created in Kansas? \_\_\_\_\_
- ii. How many jobs have been preserved in Kansas? \_\_\_\_\_
- iii. How many jobs have been terminated in Kansas? \_\_\_\_\_

C. As a result of the project that you undertook with MAMTC, how much less are your annual operating costs? (Assume a level of sales equal to your firm's current level.) \_\_\_\_\_

(Note: "operating costs" includes labor, materials, services, utilities, and other overhead except capital acquisition.)

3. As a result of the project that you undertook with MAMTC, has your firm added any additional plant or equipment?  
 yes                       no If yes, what is the amount you spent \_\_\_\_\_

4. To what extent would you attribute the employment, sales, and other activities listed above as resulting from MAMTC's services or facilities? Please use a scale of 1 through 10 with 1 indicating MAMTC had almost no role, and 10 indicating that the activities could not have been undertaken without MAMTC. \_\_\_\_\_

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