PART 5

Bringing the Knowledge Economy Home: The Role of State and Local Governments

Earlier chapters of this Yearbook have focused on the global repercussions of the knowledge economy. Part 5 addresses the effects of the knowledge economy at the local and state level. States are looking increasingly toward their S&T infrastructure and academic R&D centers as a means of spurring economic growth. One of the recourses available to states that possess "historically low levels of federal R&D funding" has been the Experimental Program to Stimulate Competitive Research (EPSCoR). EPSCoR creates programs that use a state's academic S&T centers in ways that can improve the state's economy. As in non-EPSCoR states, growth in the biotechnology, IT, and computer technology industries have provided the backbone of economic growth. The following three chapters outline the successes and challenges Kansas, Pennsylvania, and Georgia have faced in adapting to the knowledge economy.

In Chapter 16, Richard Bendis, of the Kansas Technology Enterprise Corporation, relates the success that Kansas, an EPSCoR state, has had in progressing from an agricultural to a technically oriented economy. To illustrate the shift, he points to the fact that "about 20 percent of our economy is manufacturing, which is actually higher than the national average." He attributes much of the state's success to its ability to bridge gaps between industry and academia in the science and technology infrastructure. He highlights the state's achievements by pointing out that Kansas now ranks first in the country in state government R&D expenditure per capita. According to Bendis, the EPSCoR program has allowed the state to begin to develop "collaborative programs with industry that are important to our economy and the researcher's interest." While he is encouraged by the success they have had, Bendis believes that it will take the continued collaboration and investment of government, academia, and industry if Kansas is to continue to develop its strength in science and technology.

Timothy McNulty of the Pennsylvania Department of Community and Economic Development details the changes that have taken place

in the Keystone State. In Chapter 17, he reports that the state has done well in the knowledge economy, boasting that "technology jobs are growing at twice the rate of all other jobs in Pennsylvania." While technology is growing as expected around the academic centers, he points out that there has been considerable technological growth in cities such as Scranton, Bethlehem, and Oil City, that were primarily for known for their exploitation of natural resources, and production of basic materials. He says, "there are now more Pennsylvania outfits making computers and software than there are manufacturing steel." Pennsylvania is attempting to develop an S&T infrastructure that supports entrepreneurs, and attracts and cultivates a Ph.D.-level workforce. McNulty warns however, that a review of the mission for national technology policy is needed, "it has moved towards a focus on national competitive models, which is not particularly accurate."

Barry Bozeman of the State Data and Research Center at the Georgia Institute of Technology evaluates technology-based economic development (TED) programs in Chapter 18. He says, "Most states have two quite different and rarely joined economic agendas, one economic development and the other economic-social." He uses the TED program in Georgia to illustrate both the advantages and disadvantages of the dual agenda. While the state is experiencing an economic boom with growth above that of the median for all states, it is concurrently experiencing a bust, with growing income inequality along racial lines, and stagnant wages for the middle and lower classes. In order to harmonize the dual agenda, he suggests broadening the base of the program's beneficiaries. He offers that in order to create a true "win-win" TED program, states should look towards their universities. "The universities are already well positioned to play this role, and it may be the case that only some joint programming and coordination of goals is required."

16 Kansas S&T Initiatives Fuel the New Knowledge Economy

Richard A. Bendis

A nation that depends on others for basic scientific knowledge will be slow to progress in its intended position regardless of its mechanical skill. It is very easy to say that if you do not feel that same way about your state, you are going to have difficulty competing in these new global times—so states have to take control of their own destinies rather than depend on other people.

Kansas has about 2.6 million people and a gross state product of $75 billion. Most people view Kansas as an agricultural state, but actually about 20 percent of our economy is manufacturing, which is actually higher than the national average. So over the last hundred years, we have made a progression from an agricultural economy to one that is very technology oriented.

In Kansas, we have three primary organizations involved in economic development: Kansas, Inc., a strategic planning and think tank; the Kansas Department of Commerce and Housing, a traditional economic development agency; and the Kansas Technology Enterprise Corporation (KTEC), which is dedicated to science and technology and economic development.

KTEC was created by the legislature in 1986. It is basically a holding company with a diverse portfolio of programs and investment strategies and a number of independent affiliates that work within a statewide network. Less than seven percent of our $14 million budget goes to operations and overhead. The majority goes to programs that direct-

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ly further our mission, which is "to create and grow Kansas enterprises through technological innovation."

One thing that is unique about KTEC is our ability, through our legislation, to take equity and royalty positions in the investments we make in science and technology. Some states must change their constitutions or do not have the appropriate constitutions to assume stakeholder positions.

One hundred percent of our state funding comes from the Economic Development Initiative Fund, which was created for economic development purposes at the same time our economic development organizations were restructured in 1986. The EDIF is comprised of revenues from the Kansas Lottery and Gaming Commission, so no taxpayer dollars go into the funding of this KTEC programs. Because Kansas is a relatively poor with regards to technology resources, we must leverage our state investments. Most of our programs require matching dollars—whether it be from federal programs or the private sector. Because of our ability to reinvest returns that are generated from our royalties and equity positions, we have developed a sustainable development model, which becomes less dependent on public investment as the programs mature.

What are some of the unique characteristics about KTEC? It is a single entity in the state responsible for all science and technology economic development programs. A number of states have multiple organizations and have fragmented initiatives but through KTEC, all Kansas technology programs are under one umbrella.

Although we are a state agency created by the legislature, our structure is more similar to a private business. We have corporate bylaws and a 20-member Board of Directors. Because half of our board members are from industry, the private sector plays a major leadership role in directing the implementation of our programs. We have subsidiaries that are for-profit corporations but we have all the powers of a governmental agency.

KTEC has survived through four administrations—both Republican and Democrat—since its inception in 1986. Have we been successful? We view returns on investment in many different ways.

We have helped generate nearly $1 billion in sales with the companies that we work with. We have helped start up 242 companies. Almost 12,000 jobs have been created and over 400 technologies have been developed with our assistance. But, more importantly, we are starting now to generate royalties and equity returns, which can be reinvested and decrease our dependence on the lottery funds that we receive from

the state. Because we are one of the only programs that can show that we are generating returns that actually decrease our budget requirements in the future, our state legislature has been supportive of our mission.

Like any other program, we started modestly; but one way to determine whether you are successful is to look at the amount of dollars you leverage with your co-investment partners. As we have made additional investments in the state, so have our partners: the federal government, venture capitalists, and industry. With our investment partners, we have invested a total of over $480 million in technology initiatives. And, on an annualized basis, with all the partners' investments, Kansas benefits from $50 to $60 million in commitment to science and technology economic development. In fiscal year 1999, each state dollar invested in technology initiatives was leveraged by $4.70 in federal, industry, and venture capital investments.

You cannot generate a lot of jobs until you get a commercially viable product. It takes time and patience—an average five to seven years—to successfully establish a product in the marketplace. So what is occurring now is consistent growth because the investments that were made several years ago are continuing to create positive economic development trends and increased financial return on investment.

We believe in a life-cycle approach to technology support and development. Our role is to identify the gaps that exist when scientists, engineers, entrepreneurs, and corporations evolve from one stage of a life cycle to the next, and to help them cross the bridge to the next phase. That is how our programs have evolved—by identifying need and creating solutions to gaps in our science and technology infrastructure.

KTEC has three primary areas of focus. The first is research, which involves the Centers of Excellence at our research-based universities and the federal Experimental Program to Stimulate Competitive Research (EPSCoR) program. The second is our investment programs and affiliates. We created a series of seed capital funds and royalty- and equity-based investment programs in the state that we have now been managing for several years. Our third area of focus is small business assistance, which involves our manufacturing extension programs, innovation and commercialization incubators focused on technology companies, and market research organizations to help small businesses.

We started, as most states did, with Centers of Excellence at our research-based universities. These five Centers are focused around the state's strategic technology sectors: aviation; information & telecommunication; biotechnology; polymers; and advanced manufacturing.

Because Kansas is one of the underprivileged states on federal research and development (R&D) dollars, we have been designated an EPSCoR state—a federal program in which funds are allocated by different federal agencies that only states in the program can compete for. This has been a very successful program and has helped strengthen our basic research infrastructure. We created an organization in Kansas called the Kansas Science and Technology Advanced Research Program (K*STAR), which manages the National Science Foundation portion of the EPSCoR program. K*STAR has become a model for our state and is looked upon as a model for certain other EPSCoR states.

Some of the things that came out of the EPSCoR program were interdisciplinary and multi-institutional collaborative research programs, which are difficult when you have institutions and scientists competing with one another. But we are starting to develop collaborative programs with industry that are important to our economy and the researcher's interests.

One important area of focus is manufacturing. We have created a manufacturing technology center to work with small- and medium-sized manufacturers with new manufacturing processes. We have also created an industry-driven K-12 initiative called the Kansas Math and Science Education Coalition, which tries to create greater interest and awareness in the K-12 educational levels and make students aware of the career opportunities that exist in science and technology fields.

Another important area is engineering. We have found that there is a disconnect between industry, universities, and the engineers, so they formed their own consortium to bring the curriculum offerings at the universities more in line with industry skilled workforce needs.

We also have a number of technology business assistance programs. Many help with meetings, website's design and support, establishing partnerships, purchasing assistance, funding travel to Washington to meet with the federal agency heads, bridge funding, equity investments, SBIR assistance, market research, technical research, and commercialization of technologies.

Most KTEC programs require some type of payback, which is not the case with federal programs. We look at our portfolio on a return-on-investment basis. If a technology we are going to invest in is going to be successful, we would like to see a modest return so that we can reinvest those returns in promising new research and commercialization projects.

Two years ago I saw the Massachusetts Technology Index. It occurred to me that because of its wealth of technology resources, Massachusetts

did not really need such an index. Kansas, on the other hand, needed an innovation index. So we developed one of our own. Coming out of this self-analysis were some startling revelations that helped us formulate an updated five-year science and technology plan, which will take us into the new millennium.

The Kansas economy has become much more diverse than it was in the early 1980s, when we had three primary industries: agriculture, aviation, and oil and gas. We now have several industry clusters with over 20,000 employees. All of these have a technology component to them. Aerospace is our largest; then materials, which is very diverse rather than one primary material category; value-added agriculture; and information and communication technologies are our leading industry clusters.

One of the ways we are going to try to help stimulate growth is to employ two different classifications of strategic technologies. We are going to adopt a technology mega-theme this next year, and to complement that we will have an emerging technology strategy. The mega-themes will be those that are critical to the economy of Kansas and where there is global opportunity to grow. Emerging technologies will be those that are not as prominent within the state but still have significant growth opportunities.

It is encouraging to see that many of the high-tech industries we have seen in the United States and globally are also those that are growing most rapidly within the state of Kansas. Sprint is headquartered in Kansas, and information technology and telecommunications is our fastest-growing industry sector—with over 10,000 new employees in the last six years.

About 15 years ago we had five industry clusters with over 1,000 employees each in what we classify as high-tech industry. Today we have 20 clusters. While some of these clusters are just emerging, we have a lot of small clusters to build around from a high-technology perspective. We can employ more of our own people in the state and prevent our graduates from being one of our greatest exports. Developing this critical mass of different industries is extremely important for us to maintain.

One of the most significant revelations from our Innovation Index was that while most people would not classify Kansas as a technology state, over 20 percent of our wages and 12 percent of our employment is in high tech industries. Compare this to the entire U.S., which is 17.6 percent and around ten percent respectively. So from that perspective, we have a higher percentage of technology workers in our state than the

nation does as a whole. The Index also compared Kansas to our border states, and only Colorado has a higher concentration of technology workers than do we.

What are some of the elements necessary to build the innovation economy within your state or country? Research infrastructure is critical, and investment in R&D is a key component for economic development and a driving force for innovation. So how do we rank?

Kansas is not a corporate headquarters state. We have 72,000 businesses in Kansas—65,000 have 19 or fewer employees, while only 160 have 500 employees or more. Boeing, for example, is our largest employer, but Boeing is headquartered in Seattle, Wash. A lot of Boeing's core research is done outside the state of Kansas. Minimal basic research for the company is done in the state.

We rank 32nd in spending per capita in industry R&D. We need to get more industry R&D concentrated within Kansas. We receive less than one-half the national average of per capita R&D spending, and we trail several of our surrounding states.

AAAS is very interested in investment at the university level. We rank 33rd in university research investment. The University of Kansas is our largest research institution, ranking 93 out of the top 100 research institutions in the U.S. Kansas State is just on the cusp of getting to 100. Wichita State is performing about $20 or $25 million annually. If we put our whole university infrastructure together, we do about $250–$300 million in university research per year.

We have not been as competitive as we need to be with our universities. Some of the new initiatives that we are planning to undertake are going to change that dynamic. The problem is when you are 33rd in the country and you are already designated as an EPSCoR state, it is going to take a quantum leap to get you to the next tier. And getting there, requires a significant investment. Unless that investment is leveraged from all stakeholders, we are destined to stay at our present levels.

Another thing that Kansas lacks is a federal lab. Federal labs become magnets for federal funding and R&D. I do not think we are going to get a major federal lab—especially a Department of Energy lab—in the future so we are going to have to be more dependent on ourselves and generate more partnership initiatives.

One area in which we do well as a state is to invest in R&D. A recent study ranking state government R&D expenditures per capita ranked Kansas first in the country. That does not mean we have the largest

amount of dollars. We rank 10th in gross dollars, but we rank 1st per capita. There are benefits to having a small population base to spread those dollars around. But that statistic also shows that the state is essentially making up for deficiencies from the federal government and industry with its own investment. We need to attract more leverage from some of those other partners.

Our technology base is somewhat dependent on our three research institutions. If we are going to build a science environment and infrastructure, the faculty is the most critical component. Kansas faculty salaries are 90 percent of those at their peer institutions. Unless we get more competitive salaries with the peer institutions, not just the world-class institutions, we cannot make the next leap.

One of the greatest deficiencies that we have in stimulating economic growth is venture capital. On a national basis, $63 per capita is invested in venture capital. We have about one-third of that, or $23. In the latest PriceWaterhouseCoopers study that monitored the venture capital funds on a national basis, there was not a single dollar of early-stage capital that came into Kansas over an 18-month period. And if you do not have seed capital, you cannot adequately support technology entrepreneurs. That is one of the major roles that KTEC is fulfilling right now, but we need to get the technologies to an investment grade status to attract external capital. If we want to get the research out of the laboratories to become market viable, we need to have that risk capital available to help them evolve.

To address some of those deficiencies we have developed a series of investment strategies and programs. What we have tried to do at KTEC is design them so that they can be complementary with the federal or private sector programs so that we have an integrated and leveraged commercial capital network. We still have major financial gaps in the commercialization and start-up role, though.

We talk about the importance of research for the innovation economy. Education, training, and skilled workers are also important. You need to have the math, science, and engineering graduates to support the technology base and to attract businesses to your state.

Kansas universities educate more graduate-level scientists and engineers per million in population than any other state except Massachusetts. But you cannot just educate them—you have to find ways to retain them in your state and create employment opportunities. Otherwise, you have the proverbial brain drain.

U.S. Senator Pat Roberts (R-KS) has taken an interest in science and technology in the state. He wants to be the primary liaison in Washington, D.C., and has developed a committee on science and technology for the future, which is complementary to the KTEC initiative. He wants to help Kansas become more competitive within the federal infrastructure, and it is beginning to work.

We have also recognized that we need to become a more strategic with limited resources. We cannot use a peanut butter approach to our budget or our investments in science and technology by spreading limited dollars across too many initiatives. What we are planning to do by our June KTEC board meeting is to have the presidents from our three basic research institutions designate the technologies for which there can be collaborative and focused efforts within the state. We are going to make significant investments in those technologies because there have been some university turf issues in the past that we have had to overcome.

If we are going to build an innovation economy within the state, we need technology-based industry clusters, a research infrastructure to support that innovation, additional risk capital flowing into our state—by either growing our own or developing investment-grade technologies so that others are willing to invest, and we need a skilled workforce available as the innovation becomes successfully commercialized.

In October 1999, we held the first Governor's Economic Innovation Summit, which is very important to Kansas' science and technology initiatives. In order to advance science and technology in a state, you must get the administration behind these initiatives. Until the Innovation Summit, we did not have a governor who showed a commitment to science and technology.

What should the role of government be in science and technology? It should be vision and planning, identification of gaps, and helping to fill those gaps until they can be supported by the private sector. Government should also serve as a catalyst for strategic investments and should manage a balanced portfolio of basic, applied, and commercial technology research with industry. All three stakeholders, government, academia, and industry need to commit to effective collaboration.

So what are the lessons we have learned? First of all, partnerships are very important. It is critical that all stakeholders work together. Rather than each trying to develop unique missions with limited resources and infrastructure, identify projects where you can have overlap—where you have common goals and objectives. Second, you need to have matching investments where you leverage the risk rather than going it alone. Third,

you must focus on only a few things and do them well rather than focus on many things. Also, it is important to find a way for states to graduate out of the EPSCoR system and become more competitive

Change is going to happen, and it is the strongest of the states and universities that are going to survive. It is not the ones that are most skilled, but the ones who are most responsive to the rapidly occurring changes that will win.

17 Bringing the Technology Revolution Home in Pennsylvania

Timothy McNulty

The knowledge economy has changed the State of Pennsylvania in many significant ways. While there are many levels upon which to discuss these complex changes, one simple example stands out as being very powerful. It is not a high-tech industry or even a science-intensive activity, but it clearly illustrates what is at stake in this debate. It involves a Pittsburgh business that provides nighttime security to downtown office buildings—a fairly routine function in the post-industrial economy. This particular business was competing to provide security in a large complex, and they lost out on the bid. The company that won the contract is not a Pittsburgh company, nor is it located across the border in Ohio or West Virginia—it is in Australia.

That is the essence of the knowledge economy. It involves rapid breakthroughs in very fundamental and applied technology moving into the business world rapidly. They transform markets very rapidly, and they transform job skills equally rapidly. The challenge is to design the policy framework for that second economy.

This article will describe the state of the knowledge economy in Pennsylvania and how it is transforming state and federal science and technology (S&T) initiatives. It will then outline a few promising gubernatorial initiatives and explore where the state is heading. Finally, it will describe the Pennsylvania Department of Community and Economic Development's role in keeping Pennsylvania competitive in the knowledge economy.

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Background

Pennsylvania has a research and technology base built around the major research universities: the University of Pennsylvania, Penn State, Lehigh, Carnegie Mellon, and the University of Pittsburgh. We also have an industrial base of about 225,000 workers in technology fields and a large cluster of biotechnology and pharmaceuticals concerns based in Philadelphia. Increasingly, it is the integration of these two sectors that drive the Pennsylvania economy. For example, we have a major center for tissue engineering in Pittsburgh and increasing interaction of biotechnology and information technology.

We have tried to strengthen the linkage between the universities and the economy through venture capitalism. We have created two venture capital funds with a mixture of public and private sectors investment. These funds are structured so that they target the critical areas of applied development of chip design, biotechnology, and information technology. Since a portion of the public return on the money invested will be returned to basic research, we are trying to use venture capital to focus the direction of university research while continuing to expand its base of resources. It builds off of the success of our research universities, but tries to integrate it into the private sector more aggressively.

We also have a first-generation science program called the Ben Franklin Program. It has been in existence since 1983, providing seed support and equity financing to technology businesses and universities. That program, which has spawned 14,000 jobs, numerous products, and about 5,000 new companies, remains critical to the future—but by itself, it is not necessarily sufficient to get us where we need to go.

The State of Pennsylvania has fared well in the knowledge economy, especially over the last four years and particularly in the technology sector. That sector has become a significant driver of our economic growth: Technology jobs are growing at twice the rate of all other jobs in Pennsylvania, and there are more Pennsylvanians employed at this moment than at any time in our history. More importantly, the wages in Pennsylvania technology companies are generally 50 percent higher than the income and wage levels in other industries. This represents a transformation of the economic base. Most critically, this technology explosion is dispersed—it is reaching parts of the state that are not ordinarily considered technology centers.

There are three major academic centers in the state. In the Philadelphia area alone there is a high concentration of research and develop-

ment and university-based activity. Other centers are Penn State in the central region, and Carnegie Mellon and the University of Pittsburgh in the southeastern part of the state. The state has always enjoyed a rich mix of technology, large companies, and small companies, and there is extensive growth in those centers. For a technology revolution to take place in those areas is not unexpected.

The significant thing, however, about the last five years is where it is growing outside of the major academic centers. In Bethlehem, for example—a large steel and major processing center north of Philadelphia—there is now a large cluster of firms that are designing chips for Cisco and AEC. Up in Scranton—largely a coal and natural resource processing region—there is now a strong cluster of about 25 software companies, most of which serve the large financial service centers and their back-office operations. Across the northern tier, we are producing computers (there are now more Pennsylvania outfits making computers and software than there are manufacturing steel).

In Oil City, the birthplace of the oil industry, there is a huge concentration of Internet applications for community development, which is transforming the nature and the quality of life in that region. This would never have been possible had we relied on traditional investment and infrastructure centered around natural resources. I can envision Oil City becoming a major location for telecommuting and the development of new applications of home based businesses. (In rural Pennsylvania, we already have one of the highest concentrations of home-based businesses that are on eBay). The key to growth was the ability to invest heavily in information technology applications for students and workers, and to link these institutions and strategies together.

New Economy, New Challenges

There are many new challenges to face in terms of restructuring science and technology policy to take advantage of this transformation. Our ultimate test is going to be how rapidly we are able to extend this diffusion. Can we take the knowledge economy to every corner of Pennsylvania?

The principal focus of state policy in the past was on finding entrepreneurs and getting them started. While that has historically been the model of our policies, and the entrepreneur is still the central part of the knowledge economy, the entrepreneur alone is not enough to gener-

ate our economic growth. The challenge is to develop an entire infrastructure of innovation that supports the entrepreneur.

A secondary policy goal was to attract and cultivate a Ph.D.-level workforce. We could quantify our success by looking at the number of Ph.D.s., although clearly in this economy, that focus must change. Hotel clerks can now use global positioning satellite devices to help people enjoy their experience, so they have to have some level of technology capability. We therefore need a total workforce to learn from scratch.

While state policy work on the concept of technology has been linear—moving from basic to applied science in some clear fashion—the new knowledge economy is not linear. New products are going to change the economy and change jobs. It has become clear that businesses will succeed and only succeed to the extent to which they can provide infrastructure. If you can provide a business plan of total science infrastructure that helps companies get products to market fast, you will be a center of the knowledge economy.

Building a State Plan

There are four basic elements in Pennsylvania's plan to facilitate the state's competitiveness in the emerging speed-to-market economy.

1. Change the overall culture of Pennsylvania so that it is more technology focused—not just in the technology centers around the universities but all across the state. The first thing we have done is to encourage state government to use technologies such as online purchasing. We also plan to put our Web address on our state license plates beginning in September 1999.

2. Link community centers of innovation. One initiative involves training what we call the "tech community"; another lies in developing a test bed where new products—particularly in information technology—can be rapidly infused into the community. The latter involves moving a technology from a university into its surrounding community. Outside of Carnegie Mellon, in an old neighborhood called Oakland—which is a mix of old steelworkers and the more traditional ethnic community—we have established a test bed for new technologies that Lucent and software specialists at Carnegie Mellon are developing.

3. Promote the state as a home base for international start-ups. Our goal is to start companies in Pennsylvania and at the same time provide a home for international companies. Toward that end, we are creating locations at all our major universities for start-up companies from the

major national centers of innovation around the world. We now have centers in Israel, Germany, the United Kingdom, and Japan.

4. Establish and a comprehensive technology workforce development strategy. This multiple-component effort (some of which are listed below) represents the anchor of our program.

- Enhance software and computer infrastructure development for the preschool generation. We plan to connect all 4,000 licensed day care centers in Pennsylvania to the Internet. Our goal is to make sure that every child is computer-ready by the time they start school.

- Connect all schools to the Internet. Our $132 million initiative to achieve this objective has resulted in a 90 percent linkage. We now have high school students all across Pennsylvania designing Web pages for businesses, which will make them better workers and connect them to research and technology.

- Establish and support science and technology scholarships. We now provide three years of college education for any student who maintains a B average, enters a major science and technology field at a public or private university, and is willing to dedicate one year of working in Pennsylvania for each year they receive the scholarship.

Other initiatives revolve around shoring up a finance stream for the new economy. Until recently, if you were not a hard asset-based company, most state financing programs could not help you. To change that, we have created a new financing vehicle called the Pennsylvania Technology Investment Authority, which will provide "knowledge"-based asset financing: phantom stock, off-balance-sheet financing, synthetic leases, and the various forms of equity financing that knowledge-based companies need.

In a few technology areas we try to focus on bringing the entire issue together. For Pittsburgh's digital network development initiative, for example, we are combining new venture capital resources, a free university program in chip engineering, product test beds, and a business environment that changes our core structure and legal system. We are trying to create an overall platform—not to steer the economy, but to create a platform for innovation and rapid product development.

Conclusion

Despite the considerable work to date, Pennsylvania still faces several challenges for the future. First, there clearly is a need to restructure federal funding mechanisms for research and development, which are still largely based on linear models. Second, we have always had difficulty aligning the wide range of federal programs that support economic development in the state. The critical challenge is to assess every development program we operate. What is its role in contributing to the knowledge economy? What is its role in contributing to the fundamental environment for innovation and the realignment of programs around the knowledge economy?

Finally, we must critically review the mission for national technology policy. It has moved toward a focus on national competitive models, which is not particularly accurate. We need a unified vision—one that comes from listening to the technology itself. The essence of this technology revolution is how rapidly these technologies can transform lives. Technology today is transforming the state's ability to participate in the economy and the community's ability to see itself with a vibrant economic future. Therein lies the essence of the new mission for technology policy in the United States and federal investments.

18 Technology and Economic Development for Whom?: The Prospects for "Dual Agenda" State Programs

Barry Bozeman

The public policy holy grail is the "win-win" policy, one resulting in many beneficiaries and no discernible losers. Few such policies exist, of course. Most public policies set priorities among competing interests. During the past decade, one of the best places to look for the "win-win" policy has been states' technology-based economic development programs. These programs are popular with taxpayers, receive favorable press, and have broad-based and highly enthusiastic political clientele. For some reason, the states seem largely immune to the charges of "corporate welfare" or "industrial policy" so often levied at federal technology-based economic development programs. In most states, the programs are perceived as "win-win" and often are the apple of the governor's eye. To be sure, the commitment of resources to these programs rarely matches the rhetoric. Only a few states actually have significant (from a budget standpoint) technology-based economic development programs, but in almost all states, regardless of the true level of resources committed, the programs receive considerable attention.

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Well they should. My own perspective on state technology-based economic development (TED) programs is that of an evaluator. Having evaluated such programs in many states, including, among others, Iowa, New York, New Mexico, Georgia and California, I am one of the people who has provided tangible data indicating that there are often good reasons for trumpeting positive results. States' TED programs often work and their impacts generally are demonstrable. True, the programs sometimes do not have the type of impacts most popular with elected officials—massive job creation and substantially augmented state revenues. But knowledgeable and realistic supporters of TED programs find many things to like, including, particularly, increasingly favorable perceptions of the business climate of the state (Niemi, Bremer and Heel, 1999), beneficial linkage of educational and business institutions (Feller, 1997; 1992), and the support of significant number of new business ventures as well as the retention of old businesses retained (Shapira and Youtie, 1998). Even the unfortunate tendency of some state officials to provide wildly exaggerated, poorly documented claims about the TED programs fails to undermine the demonstrable accomplishments. As an evaluator, it is a delight to find public programs that work (not that uncommon) and that most people seem to like (quite uncommon).

My comments here introduce a dissonant note. In conventional terms, states' TED programs have proved successful. But are the "conventional terms" the right ones? Most states have two quite different and rarely joined economic agendas, one economic development the other economic-social. From the standpoint of economic development—new companies, high paying jobs, wealth creation—TED programs often do a lot with a little. But few such programs even address the economic social agenda—income inequality, poverty, racial and class divide. Should they?

Two Agendas: Economic Growth and Economic-Social

Using the evaluative criteria and methods typical for TED evaluations (Youtie, Bozeman and Shapira, 1999), many of the states TED programs look very good. Few produce enormous objective changes in states' economies (see Feiock, 1991; Goss and Phillips, 1997; Grant and Wallace, 1994). But if one considers the relatively small amount of money invested in such programs—generally much less than one percent of the state's budget—many seem a good investment, yielding much more in benefits than the programs cost. Since none of the TED programs are large, they tend to rely on strategic deployment of funds, industry match-

ing, and seed money. Generally, they take small amounts of money and do small, good things. Sometimes, much less frequently, they do large good things. But for whom do they do these good things?

It seems to me that the TED programs are by now sufficiently mature that we can, on the one hand, count them as generally successful, and, on the other hand, ask if they can do more. Rather than spending time and energy documenting unrealistic claims about tens of thousands of new jobs, perhaps the TED programs can garner more support by expanding the set of beneficiaries. In most states, the rate of growth for TED programs leveled off some time ago (Eisinger, 1995) and strategies of inflating accomplishments and stepping up the intensity of business lobbying have not done much to affect a flatter growth curve. One possible "win-win" program *strategy* is to expand the base of support by expanding the distribution of benefits from TED programs.

While I hold to my claim that the states' TED programs are generally quite popular, there has always been some dissent about the programs and their effects. Often, the dissenters are viewed as Luddites. Views about TED programs do often seemed to be bifurcated. In most states the vast majority of the electorate is has no knowledge whatsoever about TED programs. But among the attentive, there are often sharp splits between those who are enthusiastic advocates and those who criticize TED programs. Generally, the critics do not seek to cast doubt on the accomplishments of TED programs but to bring attention to a different set of priorities. If one's agenda for state policy includes economic growth, expanded revenues, import of capital, successful business start-ups and full utilization of the scientific and technological resources of the state, then advocacy of TED programs is almost sure to follow. However, if one's agenda is closing the income distribution gap, improving the lives of the disadvantaged, addressing the needs of the hard core unemployed, and redressing inequitable educational opportunities, then TED programs are likely to be seen through a quite different lens. Doubtless some see (however unrealistically) the funds invested in TED programs as substantial and as a threat, or at least a significant opportunity cost, for the economic-social agenda. If one is interested in the economic-social agenda, current programs seem highly attractive only if one embraces a "trickle down" theory. That is, if one is willing to assume that TED investments are not middle- and upper-income entitlement programs but also benefit persons in lower income echelons, then the TED program is "win-win" for the economic-social agenda as well. Unfortunately, the job creation evidence from evaluations of TED programs

almost always disappoints (the more careful the study, the more it disappoints) and the relatively few jobs that are created are generally not ones for which lower- and lower-middle wage earners qualify. In short, "trickle down" is a hard sell. Evidence suggests that state economic development programs often succeed in creating wealth but have only modest effects impact on job creation and unemployment patterns (Feiock, 1991; Grant and Wallace, 1994; Binghamn and Bowen, 1994).

Before assessing the advantages and disadvantages of TED programs taking on a dual agenda, I present a mini-case study of the State of Georgia's TED programs. It is an interesting case because the economy is booming, the TED programs are popular and, at the same time, income inequality is increasing rapidly.

Georgia: A Mini-Case Study

The State of Georgia and the City of Atlanta present an excellent case study for considering the two agendas, economic growth and economic-social. Let us consider the assessment of a leading economist (Downs, 1994, p. 26) who recently did a study for the Atlanta Regional Commission.

> The Atlanta region enjoys unusually favorable conditions compared with most other U.S. metropolitan areas. It has higher incomes, a more attractive physical environment and climate, a better transportation network, more harmonious race relations, and prospects for much faster growth. *If any big U.S. metropolitan area can surmount the key problems facing all of them—crime, children being raised in poverty, low-quality public education, lack of regional governance, and huge income disparities—Atlanta should be the place.* [italics mine].

In this "mini-case study" I am going to review briefly some of Georgia's TED programs and present some data on income distribution. This will not, of course, tell us much about the relationship of one to the other. I am willing to assume there is not much relation. The TED programs are neither a cause nor a remedy to income disparities or, more broadly, to Georgia's and Atlanta's disappointing level of progress on its economic-social agenda. I juxtapose these data in order to pose this question, elaborated below, "Should there be an attempt to latch together the two economic agendas?"

Let me begin with a brief profile of Georgia and its economy and a little bit about why it's booming. Georgia ranked 11th in population in

Table 1
Resident Population, Georgia and the United States
1980–2000 (projected)

	Population in Thousands					
	1980	**1985**	**1990**	**1995**	**1997**	**2000**
United States	226,546	237,924	248,765	262,761	267,636	274,634
Georgia	5,463	5,963	6,478	7,192	7,486	7,875
Georgia's % of United States	2.41%	2.51%	2.60%	2.74%	2.80%	2.87%

Source: Statistical Abstract of the United States, 1998; Table 26—Resident Population—States: 1970–1997; Table 35—State Population Projections: 2000–2025.

Table 2
Gross Products of Georgia, Southeast, and the United States

Gross Products of Georgia, the Southeast and the United States, Selected Years
In Millions of Current 1996 Dollars

	1980	1985	1990	1995	1996
United States	4,575,488	5,249,648	6,022,228	6,817,342	7,117,515
Southeast	936,329	1,091,468	1,259,138	1,491,319	1,555,303
Georgia	97,837	126,821	149,824	188,285	199,430

Southeastern Gross Product as a Percentage of the United States Gross Domestic Product

	1980	1985	1990	1995	1996
Southeast	20.46%	20.79%	20.91%	21.88%	21.85%

Georgia's Gross State Product as a Percentage of United States and Southeastern Gross Products

	1980	**1985**	**1990**	**1995**	**1996**
United States	2.14%	2.42%	2.49%	2.76%	2.80%
Southeast	10.45%	11.62%	11.90%	12.63%	12.82%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Division. Southeast Includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.

1997 with 7.5 million residents and is projected to have 7.9 billion residents in 2000, or about 2.87% of the U.S. population (see Table One). In 1996, the gross state product was nearly $200 billion (Table Two).

The State of Georgia Technology-Based Economic Development Initiatives

Georgia allocated $51.7 million to R&D-based technology development programs. While this pales in comparison to state expenditures on education, the criminal justice system and other "big ticket" items, it is nonetheless one of the more significant states. Briefly, let us review the primary initiatives under Georgia's TED program.

Traditional Industries Initiative

The Traditional Industries Initiative is designed to address industry's needs in education, training, technology transfer and R&D. Georgia spent $60 million between 1991–1995 (including $32 million industry expenditures) to relocate the Institute of Paper Science and Technology from Wisconsin to Georgia and modernize the Herty Foundation. The institute is a pilot plant for the paper industry nationwide. The Food Processing Consortium received $25,000 for the planning in 1994. Finally, the Textile and Apparel Consortium received $1 million to equip the National Textile Center and Apparel Manufacturing Center.

Economic Development Institute

The Economic Development Institute (EDI) serves as a single access point for those seeking technical assistance or information from Georgia Tech, where EDI is housed. The EDI is an umbrella organization for economic development, technology transfer, and new enterprise development activities. EDI funding comes from 60% state, 28% federal, and 12% business and industry.

A major component of EDI is the Georgia Industrial Extension Service which offers technical analysis and feasibility studies, facility planning and layout, material and product handling, production and inventory control, environmental and safety assessment, strategic planning, energy conservation, labor supply analysis, wage rate survey, and in-plant human resources training. The Advanced Technology Devel-

opment Center (ATDC), created in 1980, aims to increase the high technology business base in Georgia. The ATDC, in turn, includes a number of sub-components. The Support Service offers technical and business management services to help entrepreneurs build and operate their enterprise. The Corporate Partnering Service helps identify potential corporate partnerships between small and large companies. The Corporate R&D Support Program provides access to R&D groups of existing corporations to Georgia Tech's resources. Finally, the Faculty Research Commercialization Program provides financial and business development support to faculty members at Georgia Research Alliance universities (discussed below) to form new companies or to license the technologies for existing companies.

According to the EDI web page (www.edi.gatech.edu) the EDI last year provided technical assistance to 1,150 companies and 130 communities and economic development organizations. While the method for determining results is not specified, the EDI says that Georgia companies added or retained 2,400 jobs as a result of its efforts and that ATDC companies employed 2,500 persons and had revenues exceeding $300 million.

Georgia Research Alliance

The most widely heralded and most expensive component of Georgia's TED programs is the Georgia Research Alliance. The Georgia Research Alliance (GRA) was founded in 1990, as a three-sector partnership of the state's research universities, the business community, and the state government. Its mission is to foster economic development within Georgia by developing and leveraging the research capabilities of research universities within the state and to assist and develop scientific and technology-based industry, commerce, and business. In FY 1998, GRA received $ 42.4 million from the State of Georgia, constituting a little more than 80% of the Georgia's TED investment. A major element of GRA is attracting world-class eminent scholars to Georgia, with the presumption that the scientists and engineers will build up the scientific and technical base of the state and permit the research universities to play a key role in working with industry. The GRA programs are centered around major research centers including the following:

- Georgia Center for Advanced Telecommunications Technology (GCATT): GCATT oversees university-based research that helps

shape and support the emergence of the advanced telecommunications industry to advance the economy.

- Georgia Biotechnology Center (GBC): GBC supports for scientific programs and assistance for business and economic development. Research activities includes genetics and molecular medicine; vaccine and diagnostics development; drug design and synthesis; microbial conversion and fermentation; protein engineering and production, and biological substitutes.

- Georgia Environmental Technology Consortium (GETC): GETC's mission is to target the research strengths among Georgia's environmental scientists and engineers on the needs of Georgia.

The GRA sponsored research totaled more than $700 million (all sources) in 1996. According to self assessments, the GRA is responsible for an increase in university-based licenses from 22 in 1990 to 50 in 1996 and has yielded six high-tech startup companies. GRA researchers have established partnerships with a number of leading companies including Eastman Kodak, IBM and Hitachi USA. Understandably, the state's universities are keen on GRA programs which have by any measure been a major boon to their ability to recruit leading faculty.

Thus, GRA is the wellspring of the state's TED programs and its importance is underscored in Table Three which gives expenditures by program group for the years 1993–1999. It is important to underscore that the TED expenditures represent less than one percent of the State's total appropriations for FY2000. Of the total budget of $13.2 billion, public education receives 56.3%, human services 22.8% and public safety 8.5%. As in most state governments TED programs receive much attention by not much funding (at least not on a proportional basis).

The Bust within the Boom

During the past decade, Georgia's economy has been booming. Its growth has been well beyond that of the median for all states, even during a period general economic growth. Its growth has exceeded other regions of the southern United States. In aggregate, Georgians and, especially, Atlantans are much better off than they were ten years ago. The economic boom in Georgia has permitted the funding of widely-admired Hope Scholarships, a program to provide state university financing for

Table 3
Budget: R&D-Based Economic Development Programs of the State of Georgia

	Traditional Industries Initiatives	Georgia Research Alliance (GRA)	Advanced Technology Development Center (ATDC)	Total ($ in 1000s)
1993	.	15,050	1,555	16,605
1994	2,200	22,000	1,581	25,781
1995	5,172	44,625	1,886	51,683
1996	5,915	29,744	1,979	37,638
1997	7,615	40,129	2,282	50,026
1998	6,160	38,925	2,388	47,473
1999	7,150	42,400	2,178	51,728

Source: Budget Report 2000, 1999, 1998, 1997, 1996 State of Georgia.

all students who maintain a "B" average. The university system has had a period of unparalleled growth. The real incomes of Georgia citizens, taken in aggregate, have advanced at such a remarkable rate that one of the chief economic complaints is the cost and supply of labor.

Examining the aggregate masks the bust within the boom. Table Four gives figures for income distribution in the United States between 1970 and 1996 (i.e., before the peak of the boom). If we examine changes according to quintile we find, remarkably, that there is *only one income quintile that has been increasing steadily since 1970*. Everyone else is either declining or holding their own. Persons with only high school educations (about half the labor force) have been steadily *losing* income, when adjusted for inflation, for more than a decade. If we examine the Gini index of inequality we see that it has been increasing each decade since 1970. (A Gini coefficient of 1 is complete inequality. An index of 0 means everybody makes the same thing).

The reasons for increasing income inequality and stagnant lower- and middle-income wages have begun to receive considerable attention (e.g. Danziger and Gottschalk, 1993; Karoly and Burtless, 1995; Weinberg, 1996). Factors cited include shift to a service economy, increase in single parent households, increased opportunities for highly skilled workers at the same time as decreased opportunities for unskilled and less skilled workers, global competition, the "knowledge economy" and importance of computer skills, and increasing use of part-time workers (Weinberg, 1996).

Table 4
Percent Distribution of Aggregate Income by Quintiles

	# of Households (In 1000s)	Lowest	Second	Middle	Fourth	Highest	Median Money Income (1996 $)	Gini Coefficient of Income Inequality
All Races								
1996	101,081	3.7	9.0	15.1	23.3	49.0	35,492	0.455
1995	99,683	3.7	9.1	15.2	23.3	48.7	35,082	0.450
1990	94,312	3.9	9.6	15.9	24.0	46.6	35,945	0.428
1980	82,368	4.2	10.2	16.8	24.8	44.1	33,763	0.403
1970	64,374	4.1	10.8	17.4	24.5	43.3	33,181	0.394
White								
1990	80,968	4.2	9.9	16.0	23.9	46.0	37,492	
1980	71,872	4.4	10.5	17.0	24.6	43.5	35,620	
1970	57,575	4.2	11.1	17.5	24.3	42.9	34,560	
Black								
1990	10,671	3.1	7.9	15.0	25.1	49.0	22,420	
1980	8,847	3.7	8.7	15.3	25.2	47.1	20,521	
1970	6,180	3.7	9.3	16.3	25.2	45.5	21,035	
Hispanic								
1990	6,220	4.0	9.5	15.9	24.3	46.3	26,806	
1980	3,906	4.3	10.1	16.4	24.8	44.5	26,025	

Sources: Statistical Abstract of the United States, 1998. Table No. 738—Money Income of Households. The Population of the United States, Table 15-12. Table 15-12—Share of Aggregate Household Income, by Income Quintile and Race-Ethnicity: 1970–1990. U.S. Bureau of the Census—Income 1997—Table B. Website: www.census.gov/hhes/income97. Accessed April 12, 1999.

While income inequality figures are not available for Georgia, other indicators suggest that the inequality gap may be larger in Georgia than many other states. Often the splits are along racial lines. In 1997, the median family income for whites in Metropolitan Atlanta was nearly $50,000, whereas it was $17,000 for African-Americans. The splits between metropolitan Atlanta and rural Georgia are just as sharp. Clearly, Georgia, as so much of the United States, is enjoying a boom *and* a continued bust.

It is interesting to note that income inequality data are unavailable for most states, not just Georgia. While there is a huge literature, both popular and academic, on income inequality, the issues usually are not attached to the states but, rather, are viewed as national issues (Leigh, 1995).

Two Agendas: Implications for TED Programs?

In best economic modeling tradition, let us begin with an assumption not altogether realistic, but useful for theory development. Assume a state policy leader who has a dual agenda, both traditional economic growth and economic-social, and who wishes to bring them together in the state's technology-based economic development programs. This may not be an altogether realistic assumption. History is not on the side of the melding of the two agendas. To this point, there is no clamor to expand the missions of the TED programs to address, or for that matter to even consider, the vast and deep economic divides so fundamental to our nation and its economic structure. Nevertheless, let us begin with our ideal type state leader, one who wishes to achieve economic growth and, at the same time, address joblessness, income inequality, and the needs of an under skilled labor force. Should TED programs take on a dual agenda?

Arguments Against a Dual Agenda TED Program

But perhaps the best argument against taking up a dual agenda for TED programs is that the amount of money involved is so small. When we compare TED program investments to educational expenditures (a much more obvious candidate for the dual economic agenda), we find that in every state the TED expenditures pale by comparison. In a budget dominated by education and social services expenditures, why not reserve some small amount for mainstream, unfettered aid to capitalism? Even if TED programs are, essentially, regressive middle class entitlements (a point many would reject), is it not permissible to have one quite small (proportionately) such program? Moreover, it seems possible that if the TED programs are to take on additional missions, the small amount of money may be diluted with a resulting diminution of aggregate benefit.

A related argument against TED taking on a dual agenda is that current programs stretch limited funds by leveraging and targeting, difficult to do if harnessed to an economic-social agenda. Most economic-social programs are relatively costly and focus more on distributed direct benefits than small amounts of matching and incentives money.

A third reason for keeping TED programs on their current track is that TED program officials, like everyone else, have their "core competency." Organizations, including states' technology-based economic

development programs, have distinctive organizational cultures and individuals choosing to work have much in common with respect to motives, aspirations and backgrounds. Generally, those TED programs have business backgrounds and are attracted by working with entrepreneurs. This does not mean that persons working in TED programs have little concern for poorly trained, low income labor, but they typically have little experience with them.

Finally, a state seeking a dual agenda TED program may have difficulty keeping existing political clientele happy while trying to add new objectives and new clientele. Most TED programs have spent years cultivating business leaders, entrepreneurs, and venture capitalists. The core clientele may be unsympathetic or hostile to an expanded mission.

These are formidable arguments, but there are also some good reasons to consider a dual agenda approach to TED programs. The chief argument being that the two economic agendas are not as incompatible as they may seem.

Arguments For a Dual Agenda TED Program

Perhaps the best evidence that TED programs can pursue a dual agenda is that some already are doing just that. In some states, New York comes to mind, support for industrial technology and support for labor training sometimes go hand-in-hand. Often, manufacturing extension programs bring together support services for management and for workers. Indeed, most states TED programs serve a dual agenda at least in some respects. In Georgia, for example, the Traditional Industries Initiative includes resources, albeit quite modest, devoted to training.

The single best argument for a dual agenda TED program is that such an approach would represent a *truly* win-win outcome. Certainly state policymakers would be delighted to spur economic development across the gamut of citizens, ushering in booms without hidden busts, creating wealth and at the same time increasing opportunity for the disadvantaged. States already devote massive expenditures to the dual agenda, they simply fail to bring them together. With one important exception: education.

In Georgia, less than 1% of state funds goes to TED programs, but 57% goes to higher education. Especially now that Georgia plans to reverse its policy of subtracting the amount of federal Pell grants (aimed at lower income students) from the amount of state funding for Hope scholarships, one could argue that higher education opportunity serves

a dual agenda. Related, about 80% of Georgia's TED program funding actually goes to higher education through the Georgia Research Alliance. Arguably, the states TED program is also a higher education program (though the premise is linkage to industry not labor force training). Education can be, often is, the vehicle for latching the economic development agenda to the economic social agenda. In many instances all that is required is a will to do so and to undertake joint programming with dual objectives.

Let us consider a dual agenda rationale that might appeal to TED program officials, even in those programs that have historically had no commitment to enhancing worker training or similar aspects of the economic-social agenda. Broadening the base of program beneficiaries inexorably broadens political support. In turn this could, conceivably, yield to increased investment in TED programs. This may be a particularly attractive outcome in the states where funding for TED programs peaked years ago, programs in which, according to Eisinger (1995), there is much more concern about survival than accomplishment. TED program managers often are frustrated: they continue to do good things and budgets grow very slowly, stay the same or, in real terms, sometimes decline. It is not, of course, clear that an expanded base would lead to expanded resources for TED programs, but it is a strategy that has worked in countless other programs. Transportation planners learned some time ago that the best way to build support for "smart highways" is to make sure everyone has one. In the early 1970s, the Model Cities program perfected the notion of expanding the base, first by making small towns and suburbs "model cities," and ultimately designating rural areas "model cities."

There is another vital reason to consider broadening the base, the objectives, and the evaluation criteria for TED programs: the inherent value of the economic-social agenda. All too often, the economic development agenda and the economic-social agenda are pitted against one another and one finds oneself falling into the trap of picking a side. But most business people understand instinctively that having a huge set of untrained, unskilled high school dropouts affects the state's work force and its overall economy. They understand that leaving unskilled labor behind in today's knowledge economy means that bills will come due tomorrow in the form of unemployment compensation, welfare payments and even costly new prisons. Similarly, all but the least judicious advocates of the economic-social agenda understand instinctively that

the receding tide of a slow growth state economy lowers all ships and all those on board, including those in the steerage.

In sum, the dual agenda holds obvious attractions for policymakers who design and fund states' technology-based economic development programs. But the attractions of a true "win-win" TED program (as opposed to today's more common "a-few-people-win-a-lot-and-we-hope-some-of-it-trickles-down" programs) must be balanced against the dangers of tampering with small programs that already seem to be working well. Perhaps the key is to find alternative linkage mechanisms. The universities are already well positioned to play this role and it may the case that only some joint programming and coordination of goals is required. The role of universities as sources of science and technology has received increased recognition and universities have always served as sources of workforce training and skill development. Strategies for bringing those multiple objectives together in an integrated TED program may be the best way to attain the dual agenda.

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