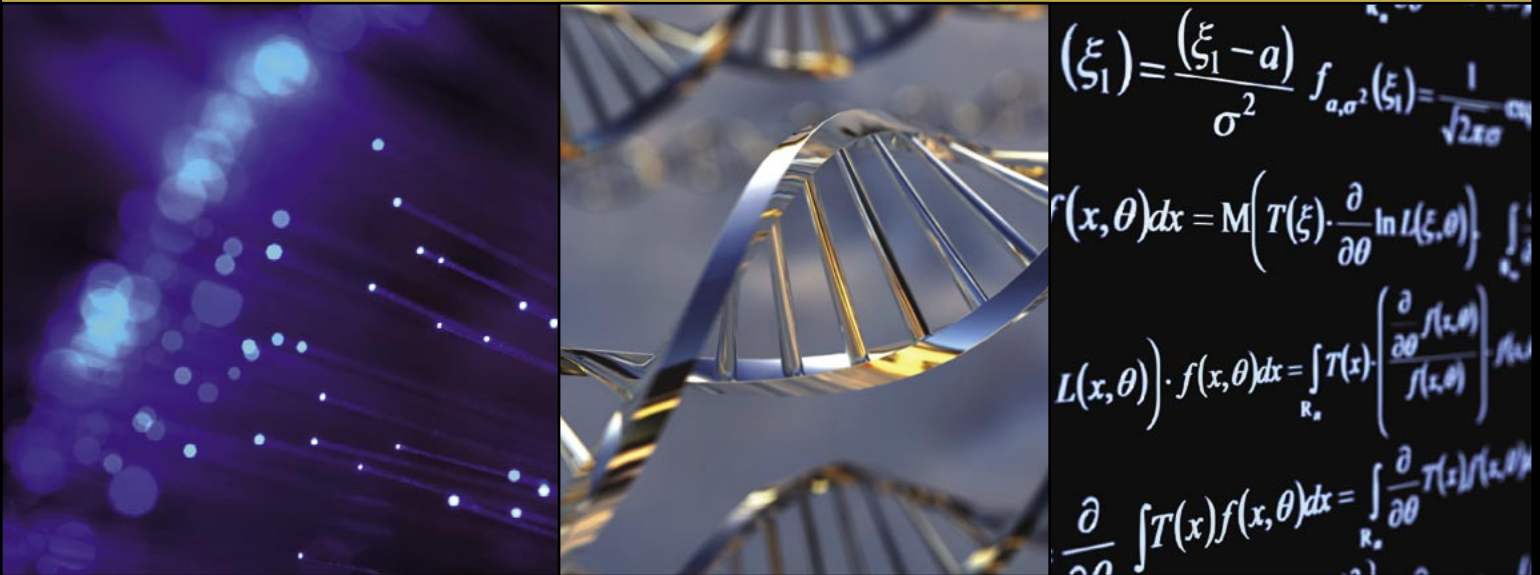


# A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona

## Executive Summary

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This report is the product of a collaborative effort between

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Our intent is to add to this body of literature by investigating the rationale for research investments across the academic literature, examining the assembled empirical evidence on the issue, conducting independent statistical analysis, and surveying what other regions, states and countries are doing to increase the pace of investment in research. The impact of research on productivity and economic activity — how it works, how it's measured — is a fascinating topic that has captured the interest of many authors. This report has clearly benefited from this extensive body of literature. We also acknowledge the broad academic community of scholars and journal editors that provided the basis for much of our analysis.

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## Backdrop

A fall 2006 report entitled *The Competitiveness Index: Where America Stands*, from the Council on Competitiveness, paints the picture of a prosperous U.S. economy where overall growth between 1986 and 2005 led the developed world and was responsible for one-third of global growth over the past 15 years. Arizona seems right in step with this performance, ranking among the leading states in overall growth as measured by overall employment growth, population growth or growth in gross state product.

So amid this apparent sea of prosperity, need there be concern about economic progress and prosperity, and if so, in what context? The 2006 report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, produced by the National Academy of Sciences, National Academy of Engineering and the Institute of Medicine, expresses “deep concern that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength.” The report prescribes a list of policy actions designed to bolster science education, increase federal investments in research, set targets for education and skill attainment in the workforce, and establish a fiscal/regulatory environment that fosters innovation. Even the ebullient Council on Competitiveness report discussed above notes a number of concerns including: the rapid growth in research and development (R&D) investments diverted to emerging economies; the decline in federal R&D investment as a share of total R&D; the reduction in the share of domestic students pursuing degrees in science and technology; the concentration of venture capital in particular regions of the country; and the lagging performance of the U.S. educational system in terms of both attainment levels and test-score achievement.

The concern can be underscored in the following example. In many developed countries, considerable energy is directed toward ensuring younger workers have the education and skills to meet the global challenge head-on. That is, younger workers tend to have higher educational attainment levels than those 20 years’ their senior. Exceptions include Germany, Italy, the United States and, most strikingly, Arizona.

### Share of population with Associate’s Degree or more

	AGE	
	25-34	45-54
Canada	51%	39%
France	33%	19%
West Germany	21%	25%
Italy	12%	11%
Japan	48%	29%
Korea	38%	13%
Mexico	18%	11%
United States	35%	36%
Arizona	30%	37%

Source: Organization for Economic Co-operation and Development (2003) and 2000 decennial census for United States and Arizona

The 2007 State New Economy Index reveals that Arizona ranks 22nd among the states. While arguably a respectable overall performance, concern may arise over the fact that Arizona is among the states whose ranking has declined the most since the index was first compiled in 1999, and that Arizona's performance is very poor on important measures, including the knowledge component of recent migrants from abroad, the importance of foreign direct investment in the state, and the index of "innovative" entrepreneurial activity within the state.

So questions remain. Are Americans, and Arizonans in particular, achieving maximum levels of economic prosperity today? And even if recent overall performance is strong, are we prepared to compete in the global economy in a manner that maintains or improves future prosperity? The analysis in this technical report, *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona*, helps inform readers about these issues and builds an understanding about how a science and engineering foundation with an emphasis on research can ensure sustainable economic prosperity.

To better understand these issues, we must first gain perspective on the big issues, which include competitiveness, the role played by productivity in achieving economic prosperity and a strategic analysis of Arizona's economic development plans. We then turn attention to the business plan for Arizona in particular and how, as revealed in this technical report, research investments can fit with the objectives of this overall plan.

## Issue Analysis

### *Understanding Competitiveness*

The "C" word elicits emotion. What country or individual does not want to compete — at least on some dimension? But it is important to understand the ultimate goal of an economic competitiveness strategy. Economic competitiveness is not about aspiring to the largest economy nor even the fastest-growing economy. It is about attaining economic prosperity for individuals and businesses that comprise an economy. And, yes, rapidly growing cities can be comprised of poor individuals. According to the 2007 *Pocket World in Figures* published by *The Economist* magazine, the 20 fastest-growing cities in the world are all in Third World countries. Kabul, Afghanistan, is No. 2.

Quoting Michael Porter in the 2006 Council on Competitiveness report, *Where America Stands*, competitiveness is "not about having a low-cost labor force, the largest share of exports or even the fastest economic growth. It is about creating the conditions under which companies and citizens can be the most productive so that wages and returns on investment can support an attractive standard of living." So the competitiveness challenge for the United States and for Arizona is less about "beating out" other economies in athletic-style "competitions," and more about understanding how the new global marketplace creates new opportunities for raising standards of living and threats to those individuals and businesses who rely on 20th century economic development strategy, markets and skills, a combination that simply may not yield sustainable economic prosperity in the coming years.

There also is a distinction between high-road and low-road competitions, as articulated by Robert Atkinson in his article, *Deep Competitiveness*, published in *Issues in Science and Technology*, Winter 2007. On the high road, winners have the best research infrastructure, the best markets to develop products and innovate, and the best climate for inventors and productive workers. Competition on this level benefits all serious competitors who are able to improve in these dimensions. Battles on the low road are characterized by counterproductive skirmishes that stifle trade, foster protectionism, set up tariffs, and instill the false belief that piracy of intellectual property is acceptable because "everybody does it."

The state and local extension of this low-road competition is manifested in battles over jobs and even local retail sales at all costs. At some point, the competitors need to move beyond competition based purely on taxes and recognize that low-paying jobs can bring more costs than benefits to a region in the long run. Competition on the high road avoids the negative consequences of this low-road engagement.

### ***Productivity, the Key to Sustainable Prosperity***

Economic prosperity and productivity are inseparable. Businesses that create high value through labor or capital input are the most prosperous. Individuals who create high value per hour of work earn the highest wages. Competitive economies maintain environments conducive to high rates of productivity growth. Evidence is abundant, most notably from the experiences of countries like Ireland, examined closely in Chapter 4 of *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona*. Celtic Tiger success is widely known and many have attempted to copy it. A catalyst for this success is a strong leadership position in productivity growth. Ireland's 2006 report of the National Competitiveness Council notes that the rate of productivity growth in Ireland over the last decade is approximately double the rate of the average European Union country and is also considerably higher than that of the United States. Using GDP as a benchmark, Ireland's hourly productivity level has actually eclipsed that of the United States.

So if productivity is the key, what fosters productivity growth? Knowledge stocks imbedded in individual businesses or particular production processes are important. "Know-how," or human capital acquired by experience and educational attainment, is important. Romer's (1990) *Journal of Political Economy* article, *Endogenous Technological Change*, explains how this operates primarily through private investments in R&D and the linkages between R&D investments, inventor innovation, returns on investment and subsequent reinvestment in R&D. Not all the knowledge created in this process is contained within the firm, but rather the benefits of this activity spill over to the surrounding economy and promote widespread productivity growth.

Historically, public investments in R&D have enhanced private-sector productivity as illustrated by the downstream impact of high-value-product development that has resulted (e.g. computers, the Internet, laser technology, technologies that support Internet search and batteries that power electronic components of all types). Productivity is the key wealth creator and R&D investments foster productivity growth.

Arizona is among our nation's leaders in job and population growth, but lags the nation in output per worker (6.1 percent below the national average) — a rough estimate of productivity — and wages per job (7.5 percent below the national average). According to The American Association for the Advancement of Science (2003, the latest year available), Arizona lags the national averages in total R&D per capita and as a percent of Gross State Product. In contrast, California and Massachusetts are among the nation's leaders in total R&D intensity and output per worker and have wage numbers that exceed national averages by more than 10 percent.

Per-capita personal income in Arizona has declined from approximately 5 percent below U.S. averages in the 1970s to about 14 percent below the U.S. average today. Estimates from the Eller College of Management at The University of Arizona predict deterioration in this performance over the coming decades.

Historically, some have argued that Arizona's cost structure is relatively low so the real purchasing power of wages is not as low as a glance at wage and income statistics might reveal. Recent acceleration in the cost of housing in the state challenges this argument, since the cost to live or relocate to Arizona is clearly much higher today than in prior decades. But rather than puzzle over whether Arizona wages are comparable to U.S. norms or 5-15 percent below, attention should focus on how to achieve sustainable wage increases by increasing the pace of productivity growth in the state. A competitiveness agenda for Arizona must be centered on measures designed to raise the productivity of the Arizona workforce.

### ***Framing the Problem: A Strategic Assessment of Arizona, Inc.***

The challenge Arizona faces today is developing a roadmap, a business plan, for the future. Suppose we think in terms of Arizona, Inc. What is our business plan to address future challenges? As part of the plan, can we create an environment that positions the state to couple leadership on overall growth (employment and population) with the aspiration to achieve leadership positions on key individual competitiveness metrics like wages and income per capita?

In terms of current strengths and weaknesses, Arizona is an overall economic growth leader and remains an attractive destination for businesses and individuals seeking employment. We have enviable overall in-migration numbers and overall economic strength that provide Arizona, Inc., the opportunity to make strategic investments that can help ensure future prosperity. But rapid population growth also increases the demand for historically low-wage service employment that requires few advanced skills. The workforce, especially younger workers, has education and skill sets that lag the nation, and a closer look at the in-migration statistics reveals that the net share of young educated in-migrants constitutes a relatively small share of Arizona's total.

As to opportunities and threats, recent overall economic strength provides opportunities that states in the industrial Midwest do not have today. Business and foundation leaders and policymakers are ready to embrace an agenda that aligns with productivity enhancement by placing greater emphasis on education and nurturing an environment conducive to innovation. Perhaps the biggest threat to our state's long-run prosperity is that the rapid, overall pace of growth may mask lagging performance on individual metrics and foster a sense of complacency. Also, Arizona will find the challenge of competing on individual prosperity metrics to be formidable because rapid population growth will continue to increase the pressure for low-wage service jobs — creating a magnet for low-skilled in-migration from all over the world. The result may be that many Arizona workers will be content to live in a pleasant climate with employment at modest means and fail to recognize the imperative for acquiring more knowledge and skills — either for themselves or for their children. If this tendency dominates, businesses may question whether Arizona is the best place to employ high-value knowledge workers. In short, Arizona faces inherent impediments that will create headwinds against progress on productivity growth, so how can these challenges be overcome?

### **A Strategy for Arizona, Inc.**

There are many aspects to an overall business plan for Arizona, Inc., and components include a series of distinct initiatives, business plans in their own right: a plan for increasing education and skills in the workforce — producing employees in Arizona and/or importing skilled workers; a plan for building transportation, energy, water and communication infrastructure; a plan for creating a business-friendly climate with a cohesive, coordinated, economic development strategy that targets high-value, export-based industries; and a plan for nurturing innovation and knowledge-economy pursuits that enhance productivity. This report, *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona*, articulates a value proposition for strategic investments in research that primarily addresses the last component in the above list and has implications for the development of human capital, as well. In short, the report provides the foundation of a business plan for Science Foundation Arizona (SFAz) — a division of Arizona, Inc., that can prove to be important to our state's success as measured by the economic prosperity of its citizens.

## ***A Business Plan for Science, Engineering and Medical Research Investments in Arizona: Science Foundation Arizona***

The recipe for competitiveness and sustainable prosperity has some key ingredients. Investments in research and development promote knowledge creation and innovation. Knowledge and innovation in turn promote human-capital development and help maximize the value of output that can be produced by each hour of input. In the end, research and development investment is perhaps “the key” to productivity enhancement. As a mechanism that fosters research and development, SFAz is an important strategic asset in the overall economic business plan for Arizona, Inc.

### ***The Concept***

How does research promote productivity and what role can the public sector, specifically a public-private partnership like Science Foundation Arizona (SFAz), play in fostering a research and development environment? Answers, based on a careful review of the academic literature, are presented in Chapter 1 of *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona*. Lessons from basic economics reveal that technological change is indeed crucial for productivity gain, that knowledge formation is key, and that knowledge doesn’t deteriorate but embodies effects that spill over to benefit other workers and businesses. Private businesses will tend to invest in R&D only if they can retain the direct benefits that accrue. They have no incentive to pay for benefits that might accrue to spillovers, and since they don’t retain all spillover benefits, private firms will underinvest in R&D. Hence the role for public research investment arises.

The analysis in Chapter 1 reveals that innovation and research, in advanced countries, are the driving forces of growth in inflation-adjusted, per-person gross domestic product. Two studies of productivity growth in the U.S. economy during the 1990s concluded that technological change and innovation — especially in the areas of information technology, supply-chain management and robotics — accounted for the largest share of U.S. productivity gains over the period.

R&D investments are crucial for knowledge creation. A key characteristic of knowledge is that it is subject to spillover. Because knowledge spillovers are fundamentally a product of human interaction, they also are highly localized. This gives rise to the phenomenon in economic geography of local research networks and innovative clusters. Examples of clustering in commercial research activity include computer operating systems in Washington, word processing and networking in Utah, biotechnology in San Francisco and Boston, industrial applications of optics in New York, and semiconductor design in Silicon Valley.

The analysis in Chapter 1 also reveals the important role that research universities provide for the nation’s innovation system and suggests that benefits will likely accrue to the regions where this knowledge creation occurs — including the potential to create an environment that is more conducive to attracting venture capital and/or additional federal research dollar investments. The state of Arizona absorbs only 0.6 percent of U.S. venture capital funds. Colorado, a state that is comparable in size to Arizona, receives five times more venture capital than Arizona. Scarcity of venture capital may be an impediment to university-driven economic development in Arizona. But evidence from other regions suggests that this hurdle can be overcome if universities and their faculty have a national presence and reputation to attract venture capital from outside the local area.

One of the most important contributions universities make to the national innovation system is the training of industrial scientists and engineers. Much of the country’s inventive activity takes place in corporate labs, but these labs are staffed by researchers who learned science and research methods at universities. Availability of scientific labor is a critical location choice consideration for corporate R&D facilities, and there is an advantage to locating in an area with a research university that trains a large number of scientists and engineers. Firms are particular about the institutions they rely on for new researchers, however. Among large firms especially, only the best graduate programs are an attracting factor.

SFAz initiatives can play an important role in the quest for federal research dollars since the program's reliance on independent competitive reviews of research proposals will serve as an excellent "proving ground" for investigators who will eventually need to tap broader pools of research support for their research projects or attempts at commercialization.

Evidence of local economic impacts from university research comes from a variety of sources, including case studies of industries born from the ideas of university scientists and econometric evidence identifying a statistical association between the level of economic activity in an area and the presence of a research university. The evidence shows conclusively that university research programs have local economic impacts, but the size of the impacts varies greatly depending on the university and its location. University research is most likely to generate significant local economic development benefits when the university has highly rated faculty and graduate programs in fields directly related to high-tech industry and when it is located in a large metropolitan area with a concentration of industrial labs and high-tech manufacturers.

### ***The Financials***

Public dollars are a scarce commodity, so exactly what types of returns can be expected from investments in SFAz? Chapter 2 examines the literature on returns to public investments, tabulating the direct results of research expenditures; the byproducts in terms of start-ups, licenses, patents produced by the activity, the inducements that occur in the private sector, and the production of human capital and related spillovers. Since the invested tax dollars come from the public sector, the "return" benefits are measured in the results that show up across the economy.

Research expenditures create jobs through traditional ripple effects, but the knowledge created by publicly funded research creates jobs in a variety of ways. University research-related licenses, start-ups and spin-off companies can have a substantial impact on the economy. In addition, the level of university research expenditures substantially influences private-sector research activities, affecting both the level of industrial R&D and industrial patents.

Human capital investments, particularly persons trained in technology, science and engineering, affect the formation of new firms. University research funding also affects overall economic growth or well-being through increases in productivity and wage rates. Research-related innovations and the accompanying jobs occur close to where the research takes place, so an important public policy goal must be to encourage high levels of both public and private research within Arizona.

Including only those components that can be empirically measured, a conservative estimate of the induced returns within Arizona for an annual, hypothetical public investment of \$10 million could be as high as an additional \$76 million per year. That would be possible even when only a portion of the expected social benefits is included in the calculations. The estimates are linear and the \$10 million example is for illustration purposes. Hence, a \$100 million investment would have impacts that are higher by a factor of 10.

Is this a "good deal" for Arizona? One is hard-pressed to identify alternative uses for public money that generates economic inducements of this magnitude. The literature also predicts that increased research investments lead to higher earnings per job. Moreover, public expenditures for SFAz can serve as the key catalyst for matching investments from private donors, federal and industry research sponsors, and the research institutions themselves. Finally, the downstream benefits in terms of the products of research, the students produced, the scientists attracted to the state and new research infrastructure yield benefits that can last for generations. So the enabling effect of an investment today by SFAz has the potential to leverage huge returns for the state's economy — returns far greater than estimates.

## ***A Value Proposition for the Regional Economy***

If investments in research have benefits that accrue to regions, evidence should be revealed in an assessment of economic statistics. What is the evidence? Have states or regions that have invested the most in R&D truly prospered? While these questions are straightforward, obtaining accurate statistical estimates is a challenge. Indeed, conducting controlled experiments in economies is one of the biggest challenges for empirical economics.

To understand the challenge, consider the Phoenix metropolitan area, where research investments total several hundred million dollars and the local economy approaches \$150 billion. The exercise seems akin to dropping a pebble in the ocean and measuring the ripples. A second aspect of the task is establishing causal relationships, e.g., do research investments enhance prosperity or do prosperous regions choose to invest in research?

Chapter 3 of *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona* examines this question using evidence on research expenditures in local universities and economic performance of 938 urban areas across the past 35 years, applying statistical techniques designed to cope with the statistical challenges outlined above.

After adjusting for cost of living, the average real wage in urban areas with even modest research university activity (in excess of \$5 million in 2004) was nearly \$3,300 higher than the average of all urban areas. The real per capita income differential was about \$2,800 higher in the research university cities. Over the past 35 years, aggregate wages and salaries in urban areas with research universities grew 0.6 percent faster per year than in areas without research universities. While seemingly a small difference, this differential annual growth rate was statistically significant and results in a 20 percent differential over the 35-year period.

In a study of this nature, it may be difficult to disentangle the impact of research universities from the impact of city size, especially when research investments are dwarfed by the size of a city. To mitigate this potential confusion, we focused exclusively on the performance of a sample of 22 urban areas that had very high levels of university research expenditures relative to the size of their economies (greater than 5 percent). Performance of each of these 22 urban areas was compared with the performance of the surrounding region (typically the cities across the rest of the state). The median aggregate wage and salary growth between 1970 and 2005 was 37 percent faster in the research university urban areas than in the surrounding region. Comparing this growth in research-intensive urban areas with cities without research universities over the past 35 years, the median value of the incremental wage and salary gain observed across the 22 areas with high levels of university research expenditures sums to about \$736 million annually today. For perspective, this exceeds average annual injections of federal research dollars by a factor of about 5-to-1. A separate analysis revealed that differential patent intensity, induced by the presence of research universities, might be the channel by which the economic impact occurs.

## ***Lessons from Ireland***

Arizona controls its own destiny and is clearly capable of charting its own course by setting economic policies that serve the interest of Arizonans. But lessons learned elsewhere can help mitigate risks for an investment like SFAz and help the effort realize its full potential. Ireland's economic success is widely documented. It is due in no small part to the aggressive economic development strategy it has pursued in courting foreign direct investment and positioning Irish businesses to export products. In short, the economic development activities are centrally focused on devising ways to bring capital into the country so Irish citizens can achieve higher levels of prosperity.

The latest addition to this economic strategy is Science Foundation Ireland (SFI). Economic development strategists understand that their historical competitive advantages — low taxes, incentives, and modest labor costs — have been mimicked by others. Most recently these strategists have chosen to compete on another dimension by bolstering the knowledge and science infrastructure of the country in an effort to attract the high-value research and development divisions of relocating companies. The flagship program, Science Foundation Ireland, launched in 2001, is the centerpiece of this new economic development strategy. William Harris, Ph.D. director of SFI from 2001 to 2006, assembled a structure that produced very favorable results. The SFI story is capsulated in Chapter 4 of *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona*.

According to an international review panel recently convened to review the activities of SFI, the effort has been successful in attracting leading foreign research scientists to Ireland and in attracting distinguished Irish researchers working abroad back to the country. Furthermore, it is directly responsible for the creation of numerous research centers and programs. Recent reports suggest that private-sector research activity has accelerated, with research and development investments by multinationals up 10 percent, and no fewer than 550 companies investing #100,000 (approximately \$130,000 in 2007) or more in R&D. Recognizing the early positives, Ireland currently plans to ratchet up investment in this effort.

SFAz achieved an important strategic advantage in attracting Dr. William Harris, an American, to return to his home country and assemble a similar research structure in Arizona. Dr. Harris has the experience (most recently from Ireland but also in his prior position at the National Science Foundation) in assembling external oversight and proposal review boards that ensure financial controls for SFAz and the integrity and accountability in the proposal-review processes crucial to the success of the endeavor. Under his direction, SFAz is not a government initiative designed to “pick winners and losers.” It is a public-private partnership that channels research dollars to the best ideas as assessed by independent review panels. Researchers looking for continuing funding will need to demonstrate results.

Indeed, Arizona is unique but must be willing to establish an aggressive economic development strategy that reflects its independence. The parallels to Ireland are informative. Travel to Ireland and you will find the passion, nationalism and pride the Irish have for their country and their economic system. SFAz, as a key division of Arizona, Inc., can help kindle that same fire of confidence and commitment among Arizonans.

### ***The Competitive Landscape***

SFAz is a new venture for Arizona, but certainly we would not be the first state to establish entities or to pass initiatives designed to promote research and innovation. Chapter 5 of *A Strategic Assessment of the Economic Benefits of Investments in Research in Arizona* inventories the initiatives in 36 other states that are attempting to enhance their research and innovation competitiveness.

The initiatives outlined range from small investments to huge multibillion-dollar initiatives. Some provide for single-year funding while others are long-term investment programs scheduled to last 10 to 20 years. The intent of the initiatives varies widely and includes: improving existing research infrastructure at universities and/or other research facilities; establishing new institutes or research centers; building new facilities and laboratories; providing funding to attract top research teams to state universities; commercializing research-driven patents and inventions; and encouraging interactions between universities and state-based companies to drive research and development, commercialization and job creation.

Recent initiatives include: the \$3 billion (over 10 years) initiative for California’s Institute for Regenerative Medicine (2004); the \$200 million (over two years) Texas Emerging Technology Fund designed to improve university research, attract top scientists, help start-up technology firms get off the ground, and move inventions out of the lab and into the market (2004); New York’s \$250 million for a new High Technology and Development program (2005); and Washington state’s \$1 billion (over 20 years, to be funded from Tobacco

Settlement money) Life Sciences Discovery Fund (2005).

Although these appear to be all new initiatives, substantial public investment in research has a long history in some states. California founded a program in 1985 designed to link entrepreneurs with University of California at San Diego researchers. In 2000, California also provided \$100 million to each of four major research centers, focusing on nano systems, information technology, quantitative biomedical research, and telecommunications and information. New York's first Center for Advanced Technology (CAT) was established in 1983 to foster university-industry collaborative research, encourage technology transfer in relevant technologies, and facilitate transfer of technology from New York's top research universities into commercially viable products produced in the private sector. There are now 16 CAT programs at universities across New York state.

Despite these efforts, New York found its share of available federal dollars shrinking while California and Massachusetts increased theirs. As a result, the New York Office of Science Technology and Academic Research (NYSTAR) was established in 2000. NYSTAR is responsible for development and oversight of eight Strategically Targeted Academic Research (STAR) Centers and five Advanced Research Centers (ARCs) through its capital-projects fund. These centers are intended to expand high-tech research and provide state-of-the-art facilities and equipment to foster the development of new technology-based jobs and business programs. NYSTAR is also responsible for a statewide network of cooperative research and development centers among private universities, private industry and state government, and oversees a network of centers that provide business planning, access to venture capital, product development, marketing, manufacturing and quality systems, engineering and information technology. NYSTAR reports that its investments have resulted in 162 patent applications, 47 patents awarded, establishment of 22 new companies, and more than \$509 million in non-state research funds to award recipients. The initiative has also created and retained more than 13,000 jobs. Further, NYSTAR efforts have substantially increased New York's share of federally funded research, making New York's universities and research centers' licensing fees the highest in the nation.

Clearly, the goals of these initiatives are to enhance growth opportunities within their state, leverage in-state research dollars in order to attract more federal funds, and ensure quality growth by focusing on research, innovation and cutting-edge technology.

## Concluding Thoughts

SFAz as a business proposition may hold particular value for Arizona. The state has three major universities and major research initiatives in its urban centers, e.g., the Translational Genomics Research Institute (TGen). It is a rapidly growing state with the capacity to make strategic investments. Arizona's attractive climate and lifestyle may help retain students who come from abroad or around the nation to participate in the research endeavors sponsored by SFAz. Most importantly, embarking on an initiative like SFAz emits a very important signal for a state like Arizona with a history of individualism and independence. It says that Arizonans can embrace public-private partnerships and understand that investments in a knowledge economy and research-enhancing infrastructure can contribute to the economic well-being of the state. Businesses and individuals who receive this signal will begin to think about Arizona in a new light — in a broader context and with a wider range of assets.

Embracing an initiative like SFAz isn't the first time Arizonans have relied on public-sponsored projects to obtain an economic stimulus. Consider the importance of Roosevelt Dam on the Salt River Valley at the turn

of the century, or when Carl Hayden, John Rhodes and Barry Goldwater convinced the federal government to build the Central Arizona Project, or when Maricopa County taxpayers voted in 1985 to build an urban-freeway system. A vibrant research infrastructure can be as fundamental for the state's 21st century economic well-being as were these stalwart public-sector investments of the 20th century.

Are Arizonans really ready to take this challenge? According to a statewide survey conducted by the Morrison Institute for Public Policy in the spring of 2006, 84 percent of respondents said science and technology are important to the state's economic development; 80 percent said science is "as important" or "more important" than reading, writing and math as a part of a good education. The survey revealed that 90 percent of respondents say it is important for Arizona to be a national/international leader in science and technology and nearly half of Arizonans would pay more in taxes if assured these revenues would be used to invest in science and technology.

Is SFAz consistent with the principles of a sound economic development strategy? As we have seen, one of the world's leading economic development organizations, IDA Ireland, certainly endorses the concept. A glance at its Web page reveals the message, *Ireland, Knowledge Is in Our Nature*. Ireland's economic development strategy, founded on the principle of low taxes and low-cost labor, has clearly made a conversion. Moreover, the structure of SFAz is especially efficient in contrast to traditional economic development efforts that focus on offering tax incentives or financial packages designed to attract downstream manufacturing companies from other regions or to compete with other regions to attract relocating firms. Because of capacity constraints, these efforts too often conflict with the achievement of other public-sector goals, such as investing in human capital. A public-private partnership like SFAz is one of the few public investments that achieves multiple goals simultaneously by providing research and development to grow in-state, generating high-value innovations and production, attracting high-value producers, and increasing investments in human capital through enhanced and expanded educational opportunities.

Is the timing right? As a review of Chapter 5 reveals, many states have addressed this concern for years, while some have embraced the science and technology agenda only after their economies encountered challenges. There appears to be increasing bipartisan support for increasing federal investments in research, including plans to increase National Science Foundation funding and launch matching grant programs that allow states to leverage research investments with federal resources.

At the same time, global competition for research and development divisions of industry is intense. Businesses now carefully consider the landscape and view public-research infrastructure and the associated education and skills of the workforce as important determinants in location and relocation decisions.

Can Arizona afford to invest in SFAz? Perhaps the better question is: Can we afford not to? Arizonans are at crossroads. We can continue to take the "low road" of economic development and attract low-wage industry to a low-service, low-wage state, or we can leverage existing world-class resources and invest in the research and technology needed to grow quality, high-wage jobs. Today, we can make a reasoned choice, not a choice made from concern over a stagnating regional economy, but a choice based on a position of regional economic strength with the intent of maintaining overall regional economic strength in the future. But it is also a choice by individuals, for individuals, with the intent of increased economic prosperity for all Arizonans.





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