



LESSONS FROM THE 'IRISH MIRACLE'

June 2005

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**P³ | PRODUCTIVITY AND
PROSPERITY PROJECT**

ASU W. P. CAREY
SCHOOL of BUSINESS
ARIZONA STATE UNIVERSITY

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**A Report from the Productivity and Prosperity Project (P3),
Supported by the Office of the University Economist**

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TABLE OF CONTENTS

Lessons From the Irish Experience	1
Convergence Facts	2
Irish and Asian Miracles Compared	2
A Framework for Analyzing Competitiveness	4
Creation of a Strong Industrial Core	6
The Apple Story	6
Ireland Today and Tomorrow	6
Ireland and Arizona: Comparisons and Opportunities	8
Opportunities for an “Arizona Miracle”	9
The Role of Government	9
Conclusions	12
References	13

LIST OF TABLES

1. Population in 2002	14
2. Value of GNP	14
3. Gross Product Per Capita and Per Employee	15
4. Estimated Total Labor Force and Number of Persons at Work in the Main Branches of Economic Activity	15
5. Unemployment Rates	16
6. Trade Union Participation Rates	16
7. Education Statistics	16
8. R&D Expenditures at Universities	18

LIST OF FIGURES

1. Diamond of National Advantage	4
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LESSONS FROM THE IRISH EXPERIENCE

In 1987 Irish GDP per person was 69% of the EU average (adjusted to EU 15); by 2003, it had reached 136%. Unemployment fell from 17% in 1987 to 4% in 2003; and government debt shrank from 112% of GDP to 33%. Annual GDP growth in the decade of the 1990s averaged a tigerish 6.9%. Perhaps even more impressive, after a downward blip coinciding with the American and, especially, the information-technology (IT) slowdowns in 2001-02, the economy is bouncing back: growth both this year and next is expected to be around 4-5%. (*The Economist*, October 14, 2004).

In recent years Ireland has made a remarkable transition. In 1987 it was Europe's worst performing economy. Today it is Europe's best performing economy. While the drivers behind this phenomenal change are many, there is no doubt that policy and investment decisions and "corporatist" social partnerships with business and industry played key roles. In the 1980's government sent clear signals that Ireland would offer a business climate that was "business friendly while making strategic investments that improved the quality of the workforce and helped stem the tide of out-migration than had limited growth. This commitment to strategic investments continues to today in Ireland and focus on nurturing science-based industries is at the center of the strategy. Ireland has become a resilient and powerful economy in a matter of decades, groomed a workforce that is the envy of nations around the world and have become a powerhouse of the knowledge economy, ranking number one in their proportion of creative class workers.

Professor James Burnham sums up the Irish miracle in a simple statement: "Fortune favors the well prepared." While market forces and factor endowments beyond a country's control have often been used to explain the pattern of internationalization and global investment, foresight and strategic policy decisions have a significant role to play in driving the competitive success of a country. Was Ireland simply the recipient of good fortune? The policy decisions that placed Ireland in the position to reap the benefits of growth and prosperity were key ingredients. The Industrial Development Authority (IDA) was essential in persuading Ireland's Regional Technical Colleges to emphasize programs in electrical engineering and information technology, so that by 1993 the share of science and technical graduates in the 25-to-34 age group of the labor force in Ireland was the highest of all OECD countries.

Ireland's excellence in telecommunications is a perfect example of the role of strategic public and private sector investments in creating economic growth and vitality in high-tech industries. Ireland made a deliberate policy choice in the early 1980s to invest heavily in communications infrastructure. In a matter of several years the telecommunications industry transitioned from a lumbering inefficient state-owned enterprise, which delivered comparatively inferior service, to a "self financing" state enterprise responsible for massive improvements in Ireland's telecommunications infrastructure. The lesson here is not telecommunications per se, nor is it even the structure of a Telecom Ireann: It is the potential for gains derived from strategic private- or public-sector investments, and that these investments can provide the triggers for changing macroeconomic growth trajectories.

We can draw many lessons from the "Irish Miracle." Chief among these is that there must be an impetus—a targeted investment strategy coupled with key policy initiatives aimed at growth and

development in promising industries—in order to bring about the kind of radical turnaround Ireland experienced.

Convergence Facts

For most of the postwar period, Ireland had been one of Europe's most serious economic under-performers. Per capita Gross Domestic Product in Ireland was only 66 percent of the European Union average in 1960, and by 1987 it was still only 69 percent of the EU average. Then, beginning in the late 1980s, Ireland started to catch up. GDP growth in the 1990s averaged almost 7 percent per year. By 2003, Ireland's per capita GDP was 136 percent of the EU average.¹

It is no surprise that Ireland has closed the gap in living standards with the rest of Europe. Economic theory suggests that living standards in different regions should converge over time, provided that institutions are in place to support markets and the regions are open to trade, investment and labor flows. Ireland long has had institutions that would support a market economy, including the rule of law, respect for private property, high quality public administration and a well-developed financial system. During the 1960s, Ireland moved away from protectionism, unilaterally reducing tariffs and encouraging foreign investment. Ireland joined the European Economic Community in 1973. Educational attainment was also rising as a result of universal adoption of free secondary education instituted in 1967. All of the preconditions for convergence were in place as early as the 1970s. What is puzzling about Ireland is that it did not catch up with the rest of Europe sooner.

Background – Irish Convergence

What seems to have been most important in postponing economic convergence in Ireland was unusually poor fiscal policy from 1973-1986. Unfavorable world financial developments in the early 1980s pushed Ireland further into fiscal calamity. Driven by a desperate need to avoid a full-scale debt crisis, the incoming government in 1987 enacted the biggest spending cuts Ireland had seen in 30 years. The primary budget deficit was eliminated in 1987 and the debt-to-GDP ratio started falling. With macroeconomic stability restored, the stage was set for rapid long-term economic growth in Ireland.

Irish and Asian Miracles Compared

The high rates of economic growth sustained by Ireland over the past decade are without parallel in recent Western economic history, but they are reminiscent of the exceptionally high growth rates recorded by Hong Kong, Korea, Singapore and Taiwan (the “Asian Tigers”) from the mid-1960s through the early 1990s and, more recently, by China. From an economic accounting

¹ Statistics on GDP exaggerate the growth in living standards in Ireland. An unusually large share of production in Ireland takes place in foreign-owned companies. Much of the income generated by these companies is repatriated in the form of profits to head offices in other countries. There is also evidence that many multinationals with highly valuable patents and trademarks (including soft-drink concentrate producers and software manufacturers) use transfer pricing schemes to recognize a high share of their global profits in Ireland where corporate tax rates are low. After adjusting for international income flows, Ireland's GNP (a measure of the income actually received by Irish nationals) is only three-quarters as large as its GDP. Nevertheless, GNP per capita has also been growing rapidly in Ireland over the past fifteen years, and even by this measure, Ireland is now roughly at parity with the EU, a sharp reversal from its position prior to 1990.

perspective, the extraordinary growth in per capita GDP experienced by the East Asian countries was largely the result of rising output per worker or productivity. Output per worker increased because of high rates of capital investment (financed by large pools of national saving) and residual productivity gains that presumably reflect improvements in technology and work processes. In Ireland, on the other hand, the extraordinary growth seems to have been mostly the result of a rise in the employment to population ratio.

The simple story is that the rise in Ireland's per capita GDP was made possible by a rise in the employment-to-population ratio.² The nation's unemployment rate fell from a high of 17 percent in 1987 to around 4 percent today. There also was a substantial increase in labor force participation, especially among women. Some of the increase in labor force participation may have been due to supply factors (i.e., a new generation of women more oriented to working and less to having children). But the bulk of the rise in the share of the population employed is thought to have been demand-driven. The Irish economy simply generated more jobs—partly because a combination of lower taxes and nominal wage restraint improved the competitiveness of Irish labor and partly because of a boom in employment opportunities at export-based, foreign-owned companies.

Foreign-owned companies played a huge role in Ireland's economic revival. Surveys by the government business development agency Forfas suggest that nearly 70 percent of employment gains in the 1990s took place in foreign-owned companies. Almost half of the job gains took place in internationally traded financial services. An important part of this activity is the "back office" work for major international banks. Employment in export-based manufacturing has grown in Ireland, in contrast to declines registered in many OECD countries. Most of this employment growth has been in modern, high-tech industries such as electronics, pharmaceuticals and medical devices where foreign-owned firms account for 90 percent of output.

Ireland has long been an attractive destination site for Foreign Direct Investment and was beginning to attract an increasing share of U.S. manufacturing FDI during the 1970s. U.S. multinationals have been attracted to Ireland for many reasons: an English-speaking work force, common law traditions, a low corporate tax rate and guaranteed access to EU markets. Predictably, FDI inflows fell off during Ireland's period of economic malaise and began to return once the Irish government got its fiscal house in order. But the extent of the boom in Ireland's foreign sector goes well beyond cyclical recovery. Ireland's economy was aided by external developments that involved a favorable coincidence of its comparative strengths and shifts in global technologies. With an existing base of production, Ireland was well positioned to benefit from the global boom in Information Technology and pharmaceutical manufacturing production. With a well-developed telecommunications infrastructure and a rapidly growing young, English-

² Capital formation does not appear to be a root cause of Ireland's success, which indicates that the gains are not the result of increased productivity but rather the deployment of labor resources that had long been underutilized. Because of a drop in public sector capital spending, gross domestic capital formation fell from a high of 30 percent of GDP in 1979 to an average of only 17 percent of GDP over the period 1986-1995. Once adjustments are made to account for a handful of manufacturing industries for which measured outputs may have been manipulated by transfer pricing, there are no dramatic productivity gains apparent in Irish manufacturing.

speaking, educated work force, Ireland was a natural place to source IT jobs such as computer-assisted call centers and more sophisticated financial services.

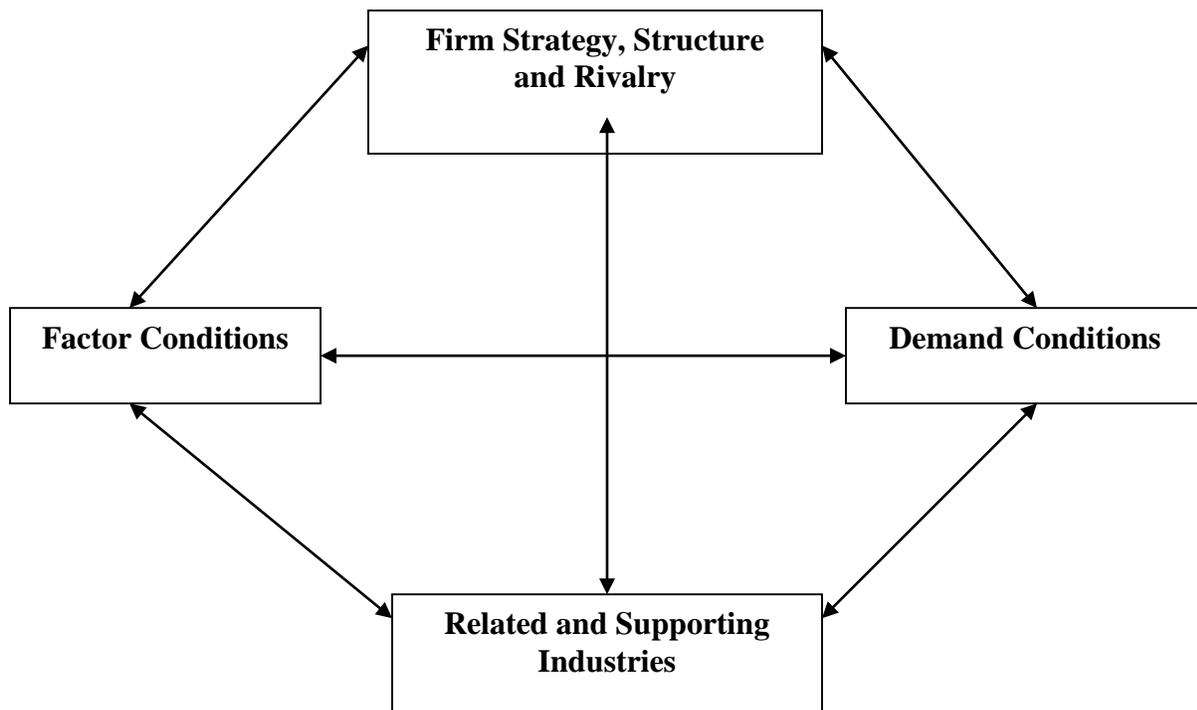
A Framework for Analyzing Competitiveness

Professor Michael Porter explains, in his Diamond of National Advantage framework (see Figure 1), the factors that contribute to the competitiveness of a country. The framework is useful in understanding the “Irish Miracle” and determining whether Arizona is poised to experience a similar shift in growth trajectory. Porter proposes that these four country/region specific factors — Firm Strategy, Structure and Rivalry, Demand Conditions, Related and Supporting Industries, and Factor Conditions — influence the firm-level ingredients for national competitive advantage.

Demand Conditions refer to the nature of local consumption. Porter argues that to the extent that local consumers have sufficient buying power and demand sophisticated products, firms serving the local market may have an advantage in future export activities. This advantage is predicted because the demands of sophisticated local consumers force companies to develop superior products and also because local tastes and preferences may anticipate global trends. In light of recent research, which has found some empirical support for convergence in global consumer tastes and preferences, this argument is especially compelling.

Firm Strategy, Structure and Rivalry refers to the characteristics of firms currently operating within the country. Country-specific factors and institutional influences shape firm structure and

**FIGURE 1
DIAMOND OF NATIONAL ADVANTAGE**



Source: Porter, M. E. (1990). *The Competitive Advantage of Nations*.

strategy. While rivalry between firms is primarily driven by the competitiveness of the market, institutional forces such as taxes and tariffs can also affect the competitive climate businesses face. Firms prefer a low-rivalry environment so that they can extract greater rents through higher market share. However, in the long run, more intense rivalry is likely to be better for the economy as a whole because it creates pressure for continued innovation and growth.

Related and Supporting Industries refers to the competitiveness of input markets in a prospective country: The more competitive the market for inputs, the lower the cost of inputs to the firm. Additionally, firms benefit if input suppliers are also strong, globally competitive entities; risk is reduced because suppliers are not solely reliant on a single firm and the firm's supply chain is more efficient because prices and production technologies are determined through global competition. In his recent research, Porter has focused on the importance of industrial clusters and noted that positive spillover effects such as technology transfer, development of skilled labor and opportunities for strategic partnerships are increased when firms in related industries are clustered in a certain locale (Porter 1998).

Finally, Factor Conditions refers to a country's resources, such as skilled labor, capital inputs and technological base. The current stock of these factors is less important to national competitiveness than the ability for growth and renewal of these resources; in other words, having a highly skilled labor force today is less important to a country's long-run competitiveness than having the institutional machinery to continually upgrade skill levels. Porter also explains that deficiencies in factors are not necessarily detrimental to a firm's competitiveness, as the theory of comparative advantage would suggest. Deficiencies can create an innovation imperative that will in fact be a source of competitiveness.

The key firm-level ingredients are skill and resource availability, information used in strategic decision-making, the goals of individuals in companies, and the intensity of innovative pressures firms face. By changing the business climate, a country can influence firm behavior thereby optimizing for the country/region as a whole.

Ireland had several inherited advantages that helped fuel the growth trajectory shift. Ireland had a relatively young, dynamic labor pool, had suffered considerable out-migration that had the potential to be reversed and was culturally and structurally receptive to Foreign Direct Investment (FDI). From a policy perspective, several glaring anti-competitive policies were eliminated and taxes were reduced, but perhaps the overriding theme of government activity was the signal that it would no longer endure the fiscal crises that had prevailed for much of the 30 years immediately following World War II. Instead, fiscal policy would be stable, reliable, and decidedly pro-business in terms of *both* tax reform *and* support for education and training through the Regional Technical Colleges (RTC) and by providing key infrastructure support through investments in telecommunications.

Arguably one of the main attractors for the massive FDI in Ireland was the clear policy signals from the government and the IDA. Fiscal policy was crafted to support business expansion, policymakers sought and achieved trade union cooperation, not confrontation, and the IDA itself essentially served as an effective business and industry advocacy group. At the same time, educational attainment levels (graduation rates from high school and college) in the population

roughly doubled from the prior generation as students recognized the potential for returns on their investment in education, and the tide of educated youth out-migration reversed course.

Creation of a Strong Industrial Core

In the context of Porter's framework, there are distinct contributions to Ireland's success. Ireland had the advantage of proximity to a large and sophisticated European consumer market, which multinationals in the 1990s were clamoring to serve. Ireland took concerted steps to leverage the advantages afforded by its location. Ireland adopted policies that enabled MNCs to access highly attractive European markets and yet avoid complex institutional arrangements and high taxes. These policies also made input markets more competitive and upgraded skill levels to provide a high-quality labor force. Ireland was also able to create a critical mass of high-quality FDI.

Indeed, the secret to Ireland's attractiveness to capital investors is due in part to its successful courting and retention of a few key companies, which then spurred further investment. For example, Intel has invested \$5 billion in a new plant west of Dublin in the Leixlip area, which is to be the company's largest semiconductor plant outside of the United States (*The Economist*, 2004). Additionally, Wyeth has elected to locate a world-class biopharmaceutical plant in Dublin, and Dell and HP Compaq also have made substantial investments in Ireland. Besides Ireland's dedication to the creation of a highly skilled work force and a low-tax, competitive business environment, Ireland made an important strategic move to retain Apple Computers in the late 1990s, which arguably played a notable role in moving the country away from low-skill manufacturing to attract these substantial high-tech investments in recent years.

The Apple Story

In 1997, Apple Computers was one of the main employers in Cork, employing over 1,800 people, 90 percent of whose jobs were in manufacturing (*The Economist*, 2004). However, as the trend has been in other industrialized nations, these jobs were rapidly disappearing as other countries began to compete globally and erode Ireland's low-cost advantage. Rather than pull out of Ireland in favor of low-cost manufacturing alternatives, Apple chose to realign its value-adding chain and make Cork its primary European software development and support center (*The Economist*, 2004). Through targeted incentives, guaranteed skilled labor and favorable tax and industrial policy, Ireland has been able to succeed in retaining key companies like Apple, and this has communicated a signal to the rest of the business community that Ireland is not only business-friendly but also ripe for high-quality technological investment.

Yet, the Apple success can neither sustain future economic growth in Ireland nor ensure continued high-quality investment. To enjoy continued prosperity and advancement, Ireland must persistently pursue strategic partnerships with the business community and court high-quality capital investment. Irish policymakers know this and are responding.

Ireland Today and Tomorrow

Some skeptics have claimed that the Irish Miracle is a one-time event fueled by factors such as EU subsidies and employment of underutilized labor resources. However, Ireland, through recent concerted policy initiatives, has been building the proper infrastructure to prove otherwise.

Ireland in the 1980s was plagued with deficiencies in skilled labor and a history of severe economic depression. But, these deficiencies created an imperative for skill upgrade that led initially to an emphasis on science and technology in the education system and other strategic institutional investments. These investments, aimed at creating and sustaining a skilled labor force, positioned Ireland for growth and prosperity that became the Irish Miracle, and will continue to benefit Ireland as it matures into a more sustainable growth path.

In 2000, Ireland established the Science Foundation Ireland (SFI), which is charged with developing quality human capital (particularly in the areas of science and engineering), supporting innovation, and promoting partnerships between agencies and institutions (universities in particular) and business. SFI administers the country's Technology Foresight Fund and provides grants to support scientific research in areas such as biotechnology and information and communications technology. This fund consists of approximately \$735 million, with funding secured from the National Development Plan through 2006 in order to ensure Ireland's future as an internationally recognized research leader in these areas.

Investments in institutions such as SFI are helping Ireland to continue to advance into a thriving knowledge-based economy and reduce its economic reliance on manufacturing and agriculture. This shift guarantees higher-wage jobs for Irish workers and continued growth in the economy. Signs of the success of the SFI institutional arrangement already are apparent. SFI has succeeded in recruiting internationally renowned research talent. Recently, SFI-funded researchers have made strides in understanding diseases such as cancer and stroke, and this research has made waves in the international science community. Additionally, SFI has attracted investment from Bell Labs to establish a world-class engineering, manufacturing and value-chain research center in Ireland, and Siemens has established a new research facility at the Royal College of Surgeons in Dublin. Strategic partnerships between SFI and the business community have played a vital role in these and many other recent economic successes, and public support and funding commitment for excellence in science and technology research continues to attract matching private-sector investments.

Efforts like SFI stand in sharp contrast with the picture of Ireland just 20 years ago. These policies, crafted in a climate Honohan and Walsh describe as a "Corporatist Social Partnership," transmit clear signals to trade unions, domestic firms and MNCs investing in Ireland. Firms can enjoy abundant skilled labor and competitive labor markets. Moreover, institutional reforms have evolved as the result of cooperative efforts between government, business and labor. Investments in technology and science communicate the Irish commitment to long-run competitiveness and translate into a more attractive strategic opportunity for firms. Ireland's global policy position has forced existing companies to adopt a global mindset and strive for competitiveness on a global scale, and the creation of a competitive business environment has reinforced the integral role of innovation. Ireland's competitive labor market and skill pool, coupled with its targeted policy reforms and proximity to lucrative European consumer markets, has created a highly attractive investment opportunity for foreign capital and a competitive business environment with a focus on sustained global excellence in science and technology. These combined factors led to the sharp change in trajectory for the Irish economy, and position the Celtic Tiger for sustainable growth in the 21st century.

IRELAND AND ARIZONA: COMPARISONS AND OPPORTUNITIES

What can Arizona learn from Ireland? Is Arizona poised to shift growth trajectory in a similar fashion? How do the two economies compare today and over the last 20 years? Arizona can hardly be viewed as deficient in skilled labor or in the kind of financial strife that Ireland experienced in the early 1980's, yet there are some interesting parallels and lessons to be gleaned from a targeted comparison.

Demographically, the Republic of Ireland is only slightly larger than Maricopa County; the country's population is just under 4 million people, which is about 70 percent of the population of the state of Arizona (Table 1). Net immigration in 2002 was just over 40,000 in Ireland compared with 66,500 in Arizona. Positive net immigration is a recent phenomenon in Ireland. The average annual rate of growth in population lags that of Arizona over the last 17 years due to severe emigration in the late 1980s. Ireland's recent economic expansion has helped stem the tide of emigration. The rate of increase in the Irish economy has been very rapid since 1985, with average annual rates of nominal growth of GNP and GDP at 9.6 percent and 10.2 percent respectively, which exceeds the rate of nominal GSP growth in Arizona of 7.4 percent, a robust rate of nominal growth by U.S. standards over the last decade and a half (Table 2).

Perhaps a better measure of economic growth can be obtained by normalizing the output numbers for change in prices and relative size of the population or work force (Table 3). Real GNP per person soared at a rate of nearly 5 percent per annum since 1985 in Ireland and grew a robust 2.9 percent on a per-worker basis. In comparison, real GSP per person grew in Arizona by 1.3 percent and per worker by 1.2 percent over the same period. At the same time, the overall rate of employment growth in the two economies was remarkably similar (Table 4). The rate of job growth in Ireland just slightly exceeded that of Arizona on average since 1985, with the rate of service employment growing at 3.8 percent in both economies. Ireland was somewhat more successful in preserving jobs in Industry (manufacturing and construction) over the same period. Unemployment rates plummeted in Ireland over this period, falling from 16.3 percent in 1988 to 4.4 percent in 2003 (Table 5). Unemployment rates declined in Arizona as well, from 6.3 percent to 5.6 percent. Memberships in trade unions declined in Ireland over the same period (Table 6). But the decline was not nearly as large as the decline in unemployment rates.

Higher education attainment statistics for Ireland and the United States and Arizona in particular are quite similar (Table 7). The United States has slightly higher rates of college graduates than does Ireland, though Arizona and Ireland are quite similar in the proportion of college graduates in their respective populations. It is important to note however that the Irish education system is quite different from Arizona's. Irish students have more skilled trade education alternatives to the collegiate degree than do Arizonans, in part simply because of the larger role of trade unions and apprenticeship opportunities. Therefore, this statistic likely under-represents the skill level of the Irish work force. Additionally, the proportion of degrees awarded in science is sharply higher in Ireland than is observed in the United States or in Arizona. About one in four bachelor's degree recipients in Ireland is awarded in science while the share has slipped to 17.4% in the United States.

Research and Development expenditures at universities in Ireland are quite similar to those in Arizona when measured on a per capita basis, and converted to a common currency (Table 8).

However, after controlling for the number of students in Arizona universities, total R&D expenditures at Irish universities substantially exceed similar outlays at Arizona universities.

Opportunities for an “Arizona Miracle”

Are there parallels between Ireland’s path to success and opportunities that exist for Arizona? Ireland’s proximity to European markets and the skilled labor deficiency were integral parts of the impetus for strategic policy interventions, institutional reforms, and key investments in competitive infrastructure. Like Ireland, Arizona is placed to serve a unique and sophisticated consumer market. Arizona simultaneously attracts a large number of retirees and young families in search of new opportunities because of its attractive climate, quality of life and sheer growth potential. The aging segment of the population will demand sophisticated health services and command a great deal of wealth with which to consume them. As a result, Arizona arguably faces a greater demand for health-care products and services than many other locales, and therefore is in a unique position to serve this market. As the worldwide population ages, demand for sophisticated health-care products and services will explode. If Arizona can capture the opportunity to develop innovative products and services to serve local demand, it may enjoy a competitive advantage in exporting these goods and services to the world market. Arizona could be a center of excellence for the research and development of biotechnology and health-care products and services if the optimal strategic policy decisions are made.

Similarly, the Phoenix metropolitan area sprawls across a desert basin and its explosive growth over the last decade has put added pressure on the West’s already limited water and energy resources. Although impending shortages may be viewed as a deficient factor condition, as Porter explains they may also be a strategic advantage. Phoenix, and Arizona in general, faces an innovation imperative to secure future water and energy sources. Thus, the state should be a champion of innovative solutions to create stable and reliable water and energy sources to meet demand. This opportunity to develop viable solutions to resource shortages could uniquely place Arizona as a world leader in the future of natural resource management. As other locales face the shortages Phoenix soon will face, Phoenix businesses would have the opportunity to export their technologies and solutions and capitalize on research and development necessitated by Arizona’s deficient water and energy supply. Growth will not be sustained through simple models of conservation. New ideas on pricing, efficient delivery, and expansion of our water and energy resources must be a part of the equation. Without such solutions, the growth of the Phoenix area will be impeded by impending shortages, and these factor conditions will become an impediment to competitiveness. Moreover, Phoenix will miss out on the opportunity to develop the technology to address water and energy needs and the gains from serving the world demand as other locales face the same constraints Phoenix soon will face; the opportunity cost is potentially enormous.

The Role of Government

Arguably opportunities exist, but why must the government play a role in securing economic growth through targeted investment? Why not depend exclusively on private markets for capital infusion needed for these strategic investments? Government must provide the stimulus for initial research and development, particularly in the areas of biotechnology and resource management, because the upfront risk to the individual company is arguably quite large, with no guarantee that the returns will accrue exclusively to the private entity that bears the cost of the

investment. In the case of any high-tech product, the risk of competitor imitation or even institutional appropriation of technology is real in many locales. Therefore, barriers to entry for new product development may be quite high. Moreover, in the case of developing solutions to water and energy sources, government for decades has intervened by subsidizing the cost of these resources, keeping prices artificially low. Hence, the natural market forces that would intervene to create the imperative for research and development of solutions are stifled and the market provides sub-optimal quantities of innovations.

If government can act—alone or in public/private partnerships—to provide a stimulus to the business community for research and development, additional private sector investment can be attracted to overcome barriers to entry and reach a tipping point. As with Apple in Ireland, once a critical mass of high quality production is housed in Arizona, the state will become a more attractive investment opportunity and other corporations likely will follow. At this point, the role of government becomes that of maintaining the competitive environment and ensuring the supply of high-skilled labor. Additionally, to ensure competitive edge in innovation, the government can play a role in encouraging research partnerships between the universities and corporations to ensure continual innovation. The returns to taxpayers are not only the supply of sophisticated biotech products and services or progress towards securing stable water and energy sources, but also a stream of high quality jobs which will allow Arizona to maintain a healthy rate of growth with an accelerated rate of quality job creation. These gains will continue to accrue as Arizona companies export these products and services to other U.S. and foreign consumers. Strategic investments in the development of thriving biotech and water/energy resource management industries have the potential to help secure a thriving Arizona economy in the future.

The success of biotech and water and energy management products and services does not depend on a convergence in global demand; the world population ages and faces health care needs and the supply of water and energy, although more abundant in some areas than others, is inherently finite. This is why these industries are such solid choices for governmental intervention. Moreover, the consumers of these products and services may indeed be public entities. Key infrastructure components such as water and energy resources are almost universally administered, if not delivered, by public entities around the world; therefore a public/private partnership in the development of these products and services is logical. Moreover, the United States is the only industrialized nation in which health care is not centralized, therefore the same argument holds for biotech services.

The strategy outlined above is not entirely new to Arizona; indeed, certain strategic government investments (Roosevelt Dam, the Central Arizona Project, the Maricopa County freeway system) have historically resulted in handsome returns for the state and proven important in the prosperity Arizona residents enjoy today. However, the federal government was largely responsible for these initiatives, and the state's current posture toward business has supported laissez-faire policies with little effort toward major public/private partnerships. Arguably, we are at a crossroads today. State tax policy has been crafted to provide relief to average residents, leaving many businesses exposed to high rates and others dependent on carefully crafted credit and exemption provisions. Legislators typically have erred on the side of spending reduction, and many do not view government spending as an "investment" in any sense of the word. Just as the Corporatist Social Partnership signals were key for Ireland in the early 1980s, the creation of a

strategic public private partnership based on the lessons of the Irish miracle and in Ireland's investment in its economic future, via IDA and Science Foundation Ireland for example, can send an important signal to the business and science communities that a historically conservative state like Arizona recognizes the need for strategic investments that a carefully crafted, funded and controlled public private partnership models can offer.

Arguably, Ireland is better positioned today to reap the benefits of an investment in science and technology than is Arizona, but in the mid-1980s Ireland was hardly the likely candidate for reaping returns on the investments in its infrastructure that it undertook. But the investment did pay off for Ireland, transforming the country from a slow-growth trajectory entrenched in an agrarian society to a booming high-technology manufacturing economy that has become the aspirant peer of many countries/regions. Similarly, strategic investments offer Arizona the opportunity to change its growth trajectory while providing an infrastructure in water policy, energy and the biosciences that will be essential to ensure that the rapid growth likely to continue over the next 50-100 years in our state will not erode our standard of living. Further, the creation of this infrastructure will lead to the development of innovative products, services, and solutions that can be exported to meet world demand and continue to yield positive returns to Arizona businesses and residents.

CONCLUSIONS

Economic convergence was only a matter of time for Ireland. That it happened when it did and in such a short period of time was the result of both thoughtful decision-making on the part of many stakeholders and a favorable set of external economic developments. To continue to achieve rapid economic growth, however, Ireland will not be able to rely on increased labor utilization but must succeed in raising output per worker. This, in turn, will require more entrepreneurial activity and participation in higher value-added activities. Ireland will need to participate more in the creation of knowledge and not simply be operational in the application of knowledge-based technologies. The activities undertaken by the Irish Development Authority, and specifically Science Foundation Ireland, are large strides in the right direction.

Arizona, like Ireland in the 1980s, has an opportunity to change its growth trajectory. Arizona can follow Ireland's lead today and pursue the returns that can accrue from strategic investments or continue on its current path. Risks are inherent in both strategies. But the choices Arizonans make today will determine the state's growth trajectory over the next several decades—and the cost of missed opportunities if Arizona maintains the status quo could be enormous. People no doubt move to Arizona because it offers a quality of life superior to their former domiciles. Arguably, Arizona's growth industry is growth itself. To sustain its growth industry, Arizona needs an infrastructure that can simultaneously provide the foundation for individual income growth, improved individual standards of living, and overall growth. With well-designed strategic investments, these can be complementary goals rather than competing outcomes.

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Table 1

Population in 2002

(thousands)

	1986	2002	Avg Ann % Growth
Ireland	3,443	3,917	0.76%
Arizona	3,317	5,456	2.97%
Maricopa County	1,800	3,295	3.62%

Net Migration in 2002

(thousands)

Ireland	41.3
Arizona	66.5

Sources: Central Statistics of Ireland and U.S. Census Bureau.

Table 2

Value of GNP at Current Market Prices

(millions of current Euros or equivalent in 1985)

	1985	2003	Avg Ann % Chg
Ireland	21,091€	109,800 €	9.60%

Value of GDP at Current Market Prices

(millions of current Euros or equivalent in 1985)

	1985	2003	Avg Ann % Chg
Ireland	23,587€	135,200 €	10.19%

Gross State Product

(millions of current dollars)

	1985	2003	Avg Ann % Chg
Arizona	\$50,080	\$182,208	7.44%

Sources: Ireland – Budgetary and Economic Statistics 2004;
Arizona – U.S. Bureau of Economic Analysis.

Table 3

GNP per Head				Gross State Product per population			
Constant (1995) Prices				Constant 1995 prices			
Euros or equivalent in 1985				Dollars			
	1985	2002	Avg Annual Rate of Change		1985	2003	Avg Annual Rate of Change
Ireland	8,324 €	18,986 €	4.97%	Arizona	\$22,383	\$28,372	1.33%

GNP per Person at Work				GSP per Employed Person			
Constant (1995) Prices				Constant 1995 prices			
Euros or equivalent in 1985				Dollars			
	1985	2002	Avg Annual Rate of Change		1985	2003	Avg Annual Rate of Change
Ireland	27,308 €	44,233 €	2.88%	Arizona	\$55,800	\$69,385	1.22%

Sources: Ireland – Budgetary and Economic Statistics, 2004; Arizona – U.S. Bureau of Economic Analysis and Arizona Department of Economic Security.

Table 4

**Estimated Total Labor Force and Number of Persons at Work
in the Main Branches of Economic Activity**
(thousands)

Ireland			
Branch of Activity	1985	2003	Avg Ann Rate of Chg
Industry	306	493	2.68%
Services	602	1,173	3.78%
Total (non-ag) at Work	908	1,666	3.43%
1985 presented on PES Basis mid-April each year			
2003 presented on ILO Basis, March-May			
Arizona			
Branch of Activity	1985	2004	Avg Ann Rate of Chg
Industry	305	371	1.04%
Services	972	1,966	3.78%
Wage and Salary Empl.(non-ag)	1,277	2,337	3.23%

Sources: Ireland – Budgetary and Economic Statistics, 2004; Arizona – Arizona Department of Economic Security, October 2004.

Table 5
Unemployment Rates

	1988	2003
Ireland	16.3	4.4
Arizona	6.3	5.6

Ireland 2003 data is based on March-May quarterly data.
Sources: Ireland – Budgetary and Economic Statistics
2004; Arizona – U. S. Bureau of Labor Statistics.

Table 6
Trade Union Participation Rates

	1980	2000	%Chg	% Point Change
Ireland	57	38	-33%	19
U.S.	22	13	-41%	9

Source: www.usatoday.com/money/world/2004-11-10-eurolabor_x.htm

Table 7
**Public Direct Expenditures for
Education**

as a Percent of GDP, 1999

Ireland	4.3%
U.S.	5.2%

Source: NCES International Comparisons of Education,
<http://nces.ed.gov/pubs2003/2003060f.pdf>

Table 7a
Bachelor's Degree Recipients

as a Percentage of Population of
Theoretical Age of Graduation, 1999

Ireland	26.0%
U.S.	33.2%

Source: NCES International Comparisons of Education,
<http://nces.ed.gov/pubs2003/2003060f.pdf>

Table 7b

Number of Bachelor's Degree Recipients

per 100 persons of the theoretical age of graduation

	1989	1999	Avg Ann % Chg
Ireland	16.4	26.0	4.72%
U.S.	27.3	33.2	1.98%

Source: NCES International Comparisons of Education,
<http://nces.ed.gov/pubs2003/2003060f.pdf>

Table 7c

Percent of Bachelor's Degrees Awarded in Science

	1985	1999	Avg Ann % Chg
Ireland	28.8	25.8	-0.78%
U.S.	21.7	17.4	-1.57%

Source: NCES International Comparisons of Education,
<http://nces.ed.gov/pubs2003/2003060f.pdf>

Table 7d

Percent of Graduate Degrees Awarded in Science

	1985	1999	Avg Ann % Chg
Ireland	31.4	24.8	-1.67%
U.S.	13.5	13.7	0.11%

Source: NCES International Comparisons of Education,
<http://nces.ed.gov/pubs2003/2003060f.pdf>

Table 7e

College Degree Granting Institutions Enrollment

per 1,000 population

	1992	1999
Arizona	276	326

Source: U.S. Census Bureau, Statistical Abstract of the United States.

Table 7f

Educational Attainment

percent of population college graduate or more

	1990	1999	2002
Arizona	20.3	24.2	26.3
United States	20.3	25.2	26.7

Source: U.S. Census Bureau, Statistical Abstract of the United States

Table 8

R&D Expenditures at Universities

Fiscal Year 2000

	Ireland (Euros)	Arizona (Dollars)
Per Capita	63.47 €	\$89.62
Per Undergraduate	1,776.12 €	\$1,460.82
Per College Student	1,565.79 €	\$1,271.49

Sources: FORFAS survey on R&D in Higher Education; Chronicle Almanac, Vol. 51, Issue 1, p.39; National Science Foundation.

THE PRODUCTIVITY AND PROSPERITY PROJECT

The Productivity and Prosperity Project: An Analysis of Economic Competitiveness (P3) is an ongoing initiative begun in 2005, sponsored by Arizona State University President Michael M. Crow. P3 analyses incorporate literature reviews, existing empirical evidence, and economic and econometric analyses.

Enhancing productivity is the primary means of attaining economic prosperity. Productive individuals and businesses are the most competitive and prosperous. Competitive regions attract and retain these productive workers and businesses, resulting in strong economic growth and high standards of living. An overarching objective of P3's work is to examine competitiveness from the perspective of an individual, a business, a region, and a country.

THE CENTER FOR COMPETITIVENESS AND PROSPERITY RESEARCH

The Center for Competitiveness and Prosperity Research is a research unit of the L. William Seidman Research Institute in the W. P. Carey School of Business, specializing in applied economic and demographic research with a geographic emphasis on Arizona and the metropolitan Phoenix area. The Center conducts research projects under sponsorship of private businesses, nonprofit organizations, government entities and other ASU units. In particular, the Center administers both the Productivity and Prosperity Project, and the Office of the University Economist.

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