

## **TRENDS AFFECTING BUSINESS AND EDUCATION IN ILLINOIS**

In these early years of the 21st Century, unprecedented demographic changes, major technological developments, and the expanding global economy are affecting the way we live and the economic vitality of the United States and Illinois. A convergence of multiple, complex trends has resulted in a situation in which businesses are scrambling to remain globally competitive, electronic communication has created instantaneous global connections, and workers of the 20th Century need to develop new skills to remain competitive in the 21st Century.

The convergence of these trends has created several challenges for the U.S. and Illinois: a decline of the middle class, projected shortages of skilled workers, increasing global competition, and a new set of knowledge and skills needed by all citizens. Keeping Illinois competitive will require

- The simultaneous creation of new higher-paying jobs
- Increasing the science and mathematics skills of all citizens
- Increasing levels of educational attainment, especially for black and Hispanic populations
- Increasing productivity in occupations with projected critical shortages
- Recruiting and retaining the most innovative, skilled workers

# CHAPTER I

*A strong STEM education program is fundamental to building the talented workforce and providing the supportive research and infrastructure necessary for an innovative culture.*

## **CONVERGENCE OF DEMOGRAPHIC, TECHNOLOGICAL, AND GLOBALIZATION TRENDS**

The following is a simplistic description of three major trends affecting the U.S. and Illinois:

- Demographic - The population is getting older, poorer, and more ethnically diverse.
- Technological - Broadband and other media are changing how we communicate and access information. Technology is increasing productivity in major workforce areas such as manufacturing.
- Globalization - The U.S. workforce is competing with a global pool of workers, and the U.S. is only one of several world economic leaders.

Each of these statements is true; however, taken separately, they fail to convey the impact that the combined trends are having on the U.S. More than 20 recent national reports reacted to the combined trends by declaring a "crisis." Like other commentators, the Council on Competitiveness and the Business Roundtable identified an urgent need to respond to the crisis through vast improvements in mathematics and science education. For Illinois, the convergence of these trends contributes to the following:

- The decline of the middle class
- A projected shortage of skilled workers for the future
- Increasing competition due to economic globalization

Keeping Illinois competitive will require addressing these gaps in innovative ways, and a strong STEM education program is fundamental to building the talented workforce and to providing the supportive research and infrastructure necessary for an innovative culture.

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## The Decline of the Middle Class

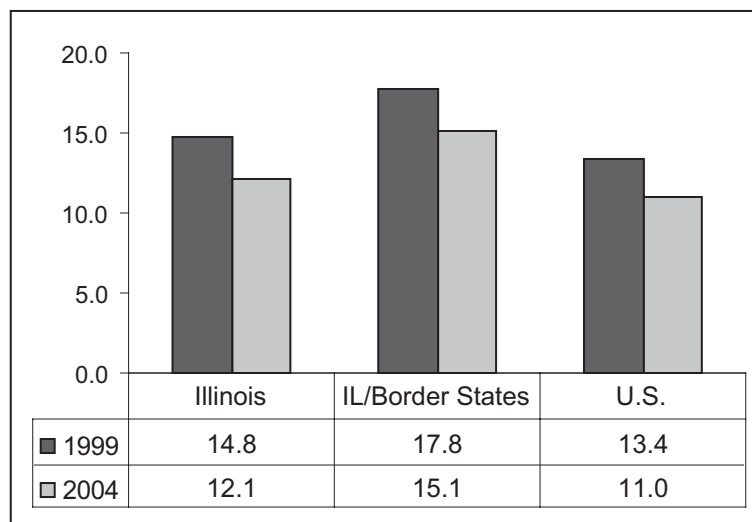
The middle class in Illinois is declining as evidenced by widening gaps in income and job opportunities for middle-tier workers.<sup>5</sup> This gap is not unique to Illinois; it is an international and national trend as well. The top 20% of U.S. workers control 85% of the U.S. wealth, and the middle tier is shrinking as the top and bottom tiers increase. Internationally, the uneven distribution of wealth is particularly evident in China, where the wealthiest 5% control half of the bank deposits, and there is great disparity between the top-tier and bottom-tier workers.<sup>6</sup>

For Illinois, a decrease in higher-paying jobs accompanied by an increase in lower-paying jobs resulted in lower household incomes and the decline of the middle class.<sup>7</sup> Often, the dislocated workers lack the skills needed for 21st Century higher-paying jobs. Keeping Illinois competitive will require increasing the number of higher-paying jobs and upgrading the skills of the work pool simultaneously.

### Decrease in Higher-Paying Jobs

Historically, Illinois has had a strong middle tier of workers with significant numbers employed in the manufacturing sector. Between 1990 and 2005, Illinois lost nearly one-fourth of its manufacturing industry jobs, representing a loss of 222,500 jobs.<sup>8</sup> In terms of the proportion of employment, in 1999, the manufacturing share of employment in Illinois was 14.8% and in the U.S. 13.4%. By 2004, the Illinois manufacturing share had decreased further to 12.1%, and the U.S. share declined to 11.0%. Illinois, along with its bordering states, had a 17.8% manufacturing share in 1999, but decreased to a 15.1% share in 2004.<sup>9</sup>

**Figure 1 Proportion of Manufacturing Employment in 1999 and 2004<sup>10</sup>**



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In addition to manufacturing, the proportion of employees in high-tech establishments decreased from 1998 to 2002 in the U.S. from 8.93% to 8.35%. Illinois experienced a similar decrease from 9.12% to 8.24%. These decreases reflect the nearly 7% of jobs in high-technology industries in the U.S. which were lost between 2000 and 2002.<sup>11</sup>

### *Increases in Jobs but at Lower Pay Levels*

During the same periods, the number of jobs in other employment sectors increased. In the nation, Illinois, and the states bordering Illinois, there were increases in employment for educational and health services, leisure and hospitality, and government, with smaller increases in the construction industry. Illinois also had small decreases in employment shares for the following: trade, transportation, and utilities; information; and professional and business services. The U.S. and Illinois' bordering states had similar declines except for professional and business services.<sup>12</sup> However, according to the Illinois Department of Employment Security, "it is clear that the recession has had a much larger impact on the employment of Illinois and its surrounding border states than it has on national employment."<sup>13</sup>

Unfortunately, the lost jobs, especially in manufacturing and high-technology, were mostly higher-paying jobs. The new jobs in education and health services paid 4.6% less than the manufacturing jobs, and the leisure and hospitality industry jobs averaged 29.2% less than the manufacturing jobs they replaced.<sup>14</sup> The net result of replacing higher-paying positions with lower-paying positions was lower household incomes.<sup>15</sup>

### *Displaced Workers Often Lack 21st Century Skills*

The displaced manufacturing and high-tech workers are having difficulty in finding employment. Even though the unemployment rates in Illinois metro areas are at the lowest levels in five years, they are still higher than the national average as Illinois struggles to recover from the declines in recent years.<sup>16</sup>

The manufacturing and high-tech jobs were lost for several reasons including increased productivity due to technological advances, increased off-shoring due to economic globalization, and displacement of work to other states. Regardless of the reasons, these jobs will most likely not return, and the new jobs in manufacturing and high-tech establishments require advanced technical skills, thus creating a situation in which the unemployed are under-qualified for the new jobs in their past occupational sectors. In fact, there is a strong link between those currently unemployed and the level of educational attainment—the highest rates of unemployment are among those with the least education.<sup>17</sup>

Technology is reshaping old jobs, including manufacturing, and defining most of the new jobs. Workers are caught in a cycle—postsecondary education is required to qualify for most livable-wage, entry-level positions; ongoing continuing education is necessary to expand knowledge and skills; and without a commitment to continually developing and updating skills, even those with previous postsecondary education can find themselves unemployable

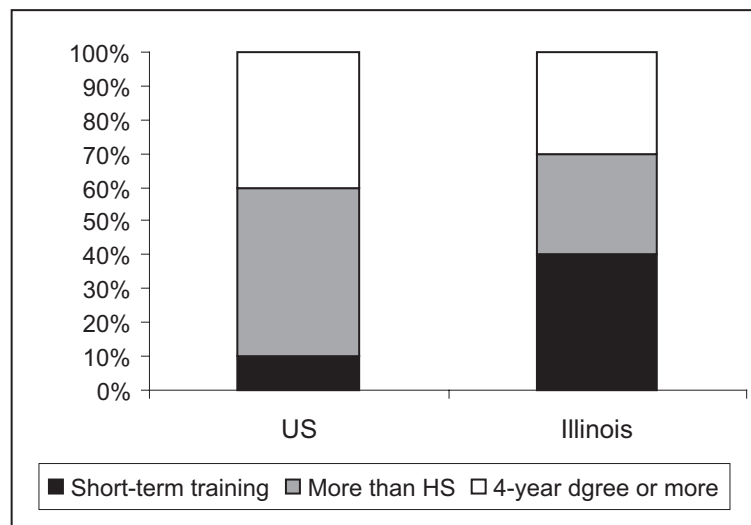
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for jobs they have previously held. Many of Illinois' unemployed engineers and computer scientists have college educations; however, the content they studied has become obsolete, and the job openings require knowledge of newer technologies.

### *Projections Indicate Continued Eroding of the Middle Class*

According to the U.S. Department of Labor, of the 30 fastest-growing occupations in 2006-2007, only 3 require short-term, on-the-job training and most require postsecondary education: 8 require associate's degrees, 10 are at the baccalaureate level, and 2 require doctorates.<sup>18</sup> In Illinois, the 30 projected fastest-growing occupations from 2002 to 2012 show a slightly different picture: 12 require only short-term, on-the-job training and 9 require a bachelor's degree or higher.<sup>19</sup> Of these 30 fastest-growing occupations in Illinois, 40.5% pay less than \$25,000 annually and 37.2% pay more than \$45,000.<sup>20</sup> If the projections hold, the middle class will continue to erode in Illinois.

**Figure 2 Percentages of the 30 Fastest Growing Occupations by Level of Required Education<sup>21</sup>**



Illinois, like most of the U.S., is caught in a double-sided challenge—the state must create high-paying jobs to bolster the middle class while also significantly increasing the skill levels of the potential pool of workers so they are qualified to fill these jobs. No matter how the state decides to overcome these challenges, a strong STEM education program is an inherent part of the solution.

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### A Projected Shortage of Skilled Workers for the Future

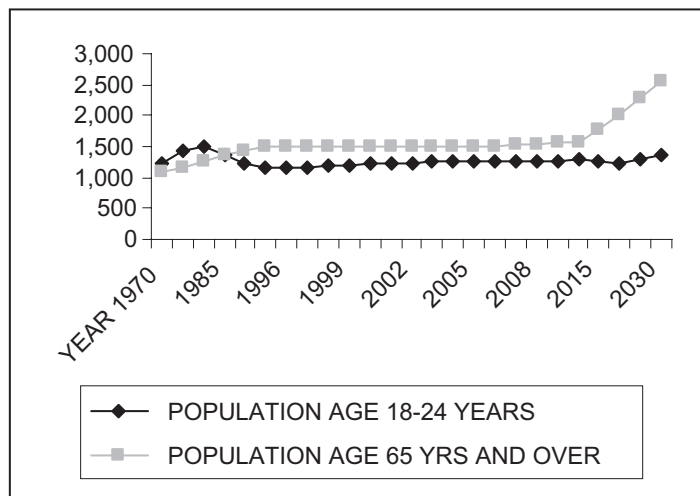
Although increasing the number of high paying jobs and increasing the skills of the work pool will help bolster the middle class, the U.S. and Illinois will face yet another obstacle in the future. Researchers predict that there will be a shortage of skilled workers due to Baby Boomer retirements, shifting demographics, and rapidly increasing, technological changes. In 2003, the Department of Commerce and Economic Opportunity (DCEO) initiated the *Critical Skill Shortage Initiative* to align regional workforce programs to a supply of workers and to build a skilled and globally competitive workforce throughout the state. Manufacturing and health care were two areas of critical shortages; both require sound STEM skills.<sup>22</sup> Keeping Illinois competitive will require increasing educational attainment, particularly of the black and Hispanic population; ensuring all workers engage in lifelong learning to keep their skills current; and investing in innovative ways to increase the productivity of occupations with potential critical shortages.

#### The Baby Boomers Retirees

According to the *Jobs Revolution*, by 2010 when the first wave of Baby Boomers reach retirement, there will be too few workers, especially workers with the necessary skills, to fill the new positions that are anticipated for the future. The projections indicate a U.S. shortfall of 1.8 million workers with two-year degrees, 3.3 million workers with four-year degrees, and 1.9 million workers with advanced degrees. There will be 30 million skilled-worker slots and 23 million Americans to fill them. By 2030, 41 million new workers will enter the workforce as 76 million will retire.<sup>23</sup>

In Illinois, the relationship between the number of “entry-age” workers (18 to 24 years old) and the number of “exit-age” workers (65 years and older) is projected to remain rather constant from 1996 through 2015. However, once the Baby Boomers reach retirement, nearly twice as many citizens will be “exit-age” as will be “entry-age.”

**Figure 3 Illinois Population at Work-Entry and Work-Exit Ages (In Thousands)<sup>24</sup>**



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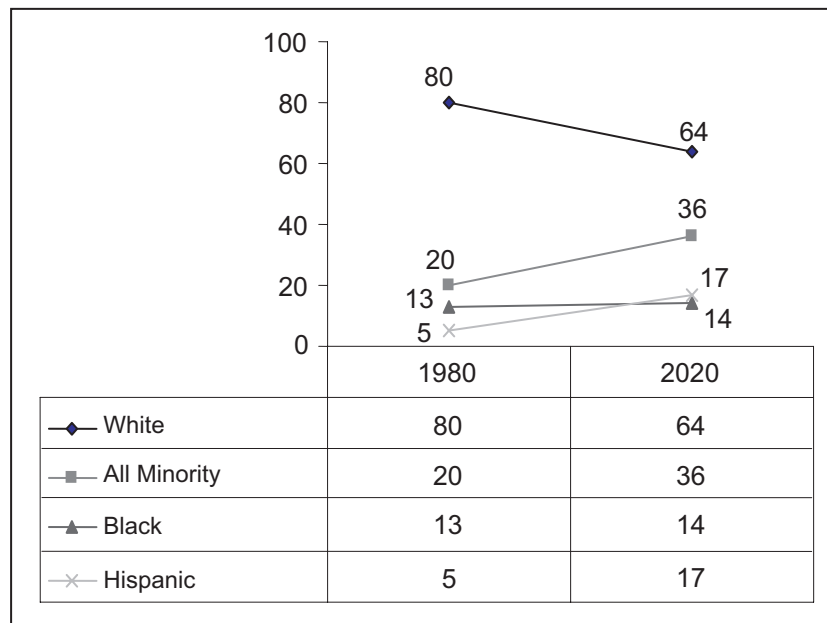
In addition, there are indications that Illinois is similar to the nation: skilled Baby Boomers are retiring in record numbers, but the new workers taking their place are largely under-prepared, particularly in mathematics and science.<sup>25</sup> Nationally, approximately half of the science and engineering bachelor’s degree holders in the labor force leave full-time employment by the age of 62, and half of the doctorate degree holders leave by age 66.<sup>26</sup> If the Baby Boomers continue to retire at these same ages, there is a potential for shortages of skilled workers and a “brain drain.”

### Educational Attainment Gaps

Keeping Illinois competitive will require a continuous increase in the educational attainment of the workforce. However, the population of Illinois is becoming increasingly diverse with the largest growth in the Hispanic population, which traditionally has lower levels of educational attainment.<sup>27</sup> In 2000, there was a significant disparity in the educational attainment of the working-age population (25 to 64 years old) in Illinois. About 22% of the black population had less than a high school credential, and a comparable (23%) proportion had some college. Over half of the Hispanic working population had less than a high school credential, and only 13% held a college degree. Among the white working age population, only 8% had less than a high school degree, and over 40% had a college degree.

By 2020, one-third of the workforce in Illinois will come from non-white groups, with the majority of growth within the Hispanic group. As workers from minority groups become an increasingly dominant part of the Illinois workforce, their education will be increasingly critical to the success or failure of the economy.

**Figure 4 Percentages of Illinois Worker-Age (25 to 64 Year Old) by Ethnicity<sup>28</sup>**

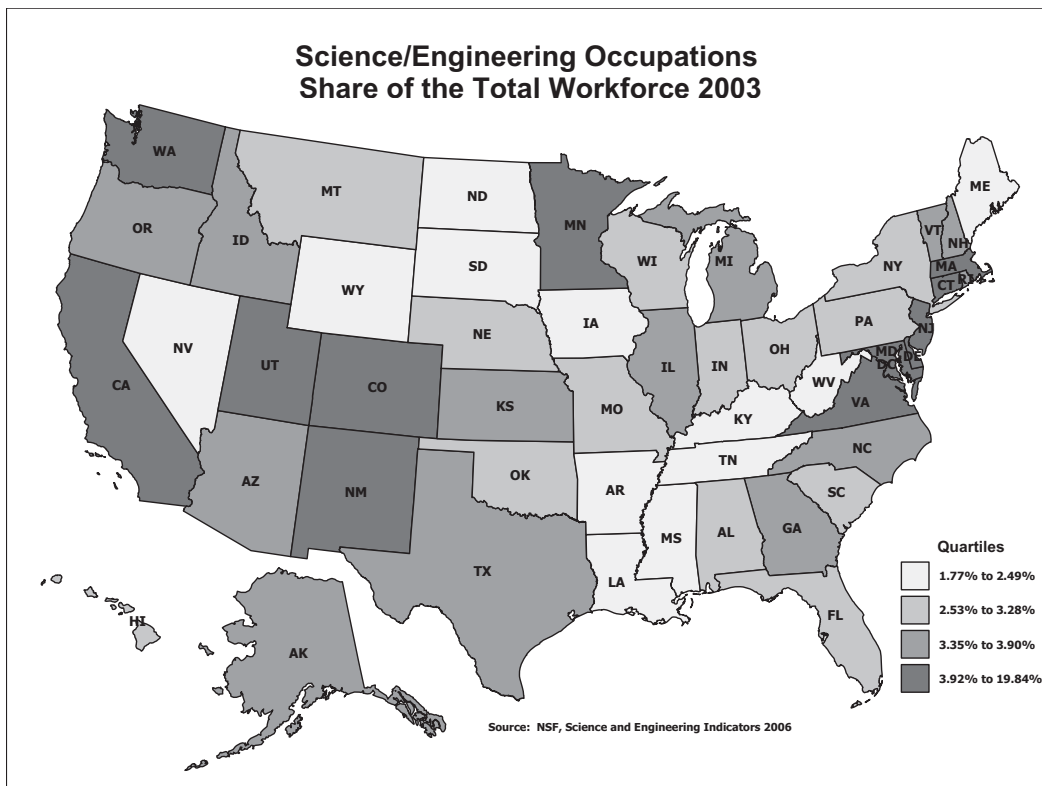


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With the possibility of a shortage of skilled workers, it will be important for Illinois to have *No Worker Left Behind*. Some states, such as Connecticut, are trying to tap the unemployed populations in inner cities, another population which historically has been under-represented in postsecondary education.<sup>29</sup> If the disparity in degree attainment does not change, the educational level of the Illinois worker will decrease as the population shifts to fewer workers from populations with higher levels of educational attainment and more workers from populations with lower levels of educational attainment.<sup>30</sup>

At the same time, the economic vitality of the U.S. depends upon innovation, which is advanced by science, technology, engineering, and mathematics. These types of advances require a cadre of the workforce with advanced degrees and skilled in research and development. During 2003 in Illinois, 3.56% of the workforce was employed in science and engineering occupations, compared to 3.61% nationwide. States in the Northeast, Southwest, and on the West Coast had the highest percentages of science and engineering occupations in their workforces.<sup>31</sup>

**Figure 5 Percentages of Workforce in Science and Engineering Occupations in 2003**

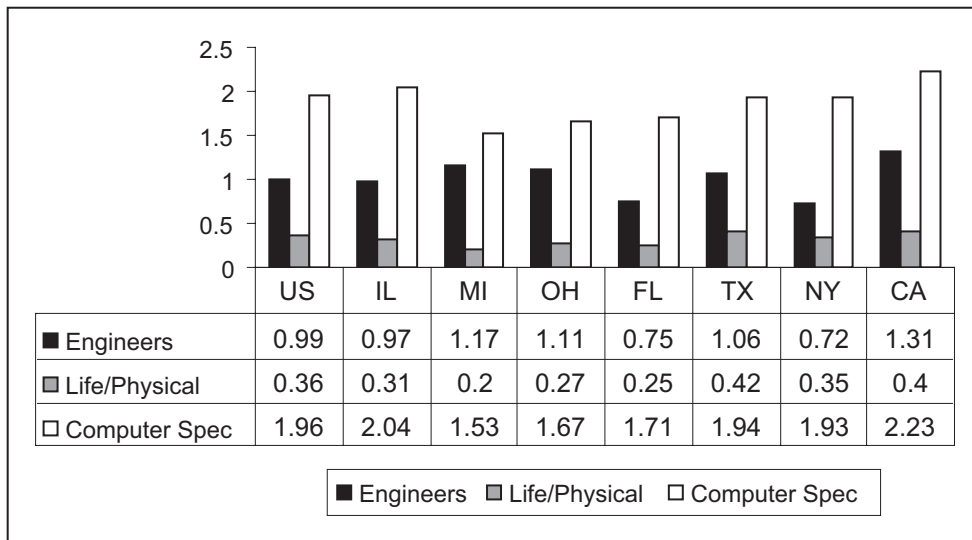


Compared to other large, industrial states, Illinois has similar total proportions of the workforce in engineering, life/physical sciences, and computer specialties. However, Illinois has a higher percentage of workers in computer specialties, except for California and fewer engineers, except for Florida and New York.<sup>32</sup>



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**Figure 6 Percentages of Workforce in Engineering, Life/Physical Sciences, and Computer Specialties in 2003**



The number of doctorate holders is commonly used as an indicator for a region’s research and development capacity. From 1997 to 2003, the number of U.S. science and engineering doctorate holders increased 13% to 568,000, representing 0.41% of the workforce. During the same period, the percent of the Illinois workforce holding science and engineering doctorates remained stable (0.35% to 0.36%), placing Illinois in the second highest quartile of states. The first quartile had rates ranging from 2.35% to 0.50% and included states such as California, Massachusetts, and New Jersey.<sup>33</sup>

In summary, the current workforce in Illinois is comparable to national and Midwest workforces in terms of the proportion of employees in science and engineering occupations. Illinois’ proportion of employment in computer specialties occupations is comparatively strong in the Midwest. However, Illinois lags behind states that are experiencing strong economic growth, such as California and Massachusetts, in the proportion of STEM employees.

Predictions indicate that Illinois, as well as the U.S., will face critical shortages of workers in the next few decades. The shortages will be in headcounts as well as in employees with the requisite knowledge and skills. Given this projected shortage of skilled talent, it becomes ever more important for public and private entities to find ways to

- Increase the educational attainment level, especially of those in under-represented groups
- Continually retain and retrain their current workers with the skills needed to keep Illinois competitive
- Increase productivity especially for jobs in which there will be a critical shortage of workers

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## **Increasing Competition Due to Economic Globalization**

Due to rapid changes in technology and political relationships, traditional boundaries are of far less importance than historically. Real-time communication, instant messaging, and virtual labs allow scientists from around the world to collaborate on research and development. The barriers once associated with time, location, language, and culture have been reduced.

As the global market and workplaces expand, innovation—once the hallmark of the U.S.—can occur anywhere. Not only can it occur, but the rapid emergence of the economies of South Korea, India, China, Singapore, Malaysia, and Thailand shows that innovation is occurring and that the U.S. faces increasing competition. The Asian countries have been particularly aggressive in recruiting top American experts in critical technologies to work at elaborate new facilities in their countries. At the same time, other nations are joining the global market, but at a much slower pace; e.g. Eastern Europe, central Asia, the Middle East, Latin America, and Africa.<sup>34</sup>

China—perceived by many as a likely pre-eminent 21st Century power—provides a good example of rapid economic globalization. The power of the country lies in the enormous number of its people—one out of five people in the world resides in China. Even though it has moved 300 million people out of poverty and quadrupled the average person's annual income, significant poverty still exists. Given the current rate of growth, China can pass the U.S. economy in 30 years; however, the U.S. will maintain a higher per capita income.<sup>35</sup>

India is another global competitor. Norman R. Augustine, retired Chairman and Chief Executive Officer of Lockheed Martin Corporation summarized the situation as "Five qualified chemists can be hired in India for the cost of just one in America...For the cost of one engineer in the United States, a company can hire eleven in India...Given such enormous disadvantages in labor cost, we cannot be satisfied merely to match other economies in those area where we do enjoy strength; rather we must excel...markedly."<sup>36</sup>

As countries around the world produce more highly skilled STEM graduates and larger pools of workers, keeping Illinois competitive will require attracting and retaining the most skilled talent. Trends in decreasing numbers of foreign-born students and increases in U.S. patents that are foreign originated indicate that a "brain drain" of highly skilled workers is a possibility as other global economies strengthen.

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### *Increasing Levels of Graduates*

One indicator of global competition is the number of college graduates produced by a country. According to one report in 2004, China graduated approximately 500,000 engineers; India graduated 200,000 engineers; and the U.S. graduated 70,000 engineers.<sup>37</sup> More recently, Duke University researchers compared only equivalent degrees and certificates and reported that in 2004, China actually graduated approximately 351,500 engineers; India graduated 112,000 engineers; and the U.S. graduated 137,400 engineers.<sup>38</sup> Regardless of the exact numbers, because their populations are so large, even a small proportion of their population will create a large number of graduates. On the other hand, South Korea graduates as many engineers as the U.S. even though it has only one-sixth of the U.S. population.<sup>39</sup>

### *Foreign-born Students and Workers in the U.S.*

In the U.S. and in Illinois, significant proportions of the workforce and science and engineering graduate programs are composed of foreign-born individuals. For example, more than half of all engineering doctorates awarded in U.S. engineering colleges go to foreign-born students.<sup>40</sup> In the 2003 U.S. science and engineering workforce, 25% of all college-educated workers and 40% of all doctorate holders were foreign born.<sup>41</sup> Over half of the doctorate holders in several fields who resided in the U.S. were foreign born: computer science (57%), electrical engineering (57%), civil engineering (54%), and mechanical engineering (52%).<sup>42</sup>

The number of foreign-born students coming to study in the STEM fields in the U.S. has begun to rise after sharp drops in the period following 9/11. Illinois sustained its population of these students. In 1999, foreign-born students made up 2.98% of all Illinois college or university students; in 2004, that number increased to 24,135 or 3.1%. In March 2006, a survey of the Council of Graduate Schools reported an 11% increase in foreign applications; however, applications are still down by 23% since 2003.<sup>43</sup>

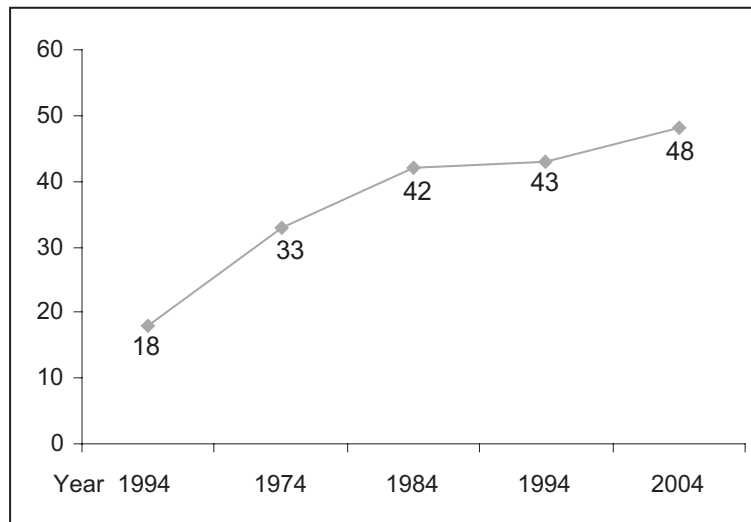
Foreign-born scientists, technologists, engineers, and mathematicians—for a long time considered the backbone of medicine and other fields—appear to be going outside of the U.S. for advanced study and employment, leaving a gap in the U.S. educational pipeline and workforce. Increasing numbers of students are graduating in STEM fields outside of the U.S. and finding positions elsewhere as well. In China during 2004, about 2.8 million students graduated from universities, and 70% found jobs in China, thus turning China into an exporter of higher education graduates.<sup>44</sup> In 2004, students from India comprised the majority of foreign students in the U.S.<sup>45</sup> Many, after graduation, returned to India's "Silicon Valley" at Bangalore. The U.S., once the major producer of STEM graduates, has increasing competition from China and other countries in not only educating the STEM workforce but in recruiting them for the workforce.

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## *Increasing Numbers of Foreign-origin Patents*

Along with the availability of a highly skilled STEM workforce, the number of patents is often used to assess the infrastructure needed for innovation. From 1994 to 2004, there has been a steady increase in the percentage of U.S. patents granted with a foreign origin, including foreign-owned companies and foreign-inventors.<sup>46</sup>

**Figure 7** Percentages of U.S. Patents of Foreign Origin 1994-2004



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### Chapter Summary

Keeping Illinois competitive requires meeting the challenges created by converging demographic, technological, and globalization trends. In this environment, the U.S., including Illinois, is experiencing a declining middle class and a potential future with too few skilled workers. Because the most recent recession had a greater effect on Illinois, it is even more critical for Illinois to take strategic action.

For Illinois, the solutions involve increasing the STEM skills of everyone; increasing the educational attainment of minority populations; recruiting and retaining the most innovative, skilled workers; investing in the STEM occupations that can provide cutting-edge solutions which increase productivity; and developing the STEM occupations that offer a livable wage and add value to the economic infrastructure.

The solutions, however, create a conundrum. If the talent pool is projected to be too small, one solution is to increase productivity, thus decreasing the need for workers. This is especially important for those occupations in which critical shortages are projected. On the other hand, increasing productivity requires innovation and a culture of research and development, which depends on a highly-skilled STEM workforce. Likewise, the STEM occupations drive innovation, which results in higher-paying jobs, but a highly-skilled, well-educated workforce is needed to fill these higher-paying jobs.

*For Illinois,  
the solutions  
involve  
increasing the  
STEM skills  
of everyone  
...and  
developing  
the STEM  
occupations  
that offer a  
livable-wage  
and add  
value to the  
economic  
infrastructure.*