

# S&E Labor Markets and Diversity: An Economic Perspective

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# Call For Action

- \* In 2005, the National Academies issued the *Rising Above the Gathering Storm* report
  - “... the United States must compete by optimizing its **knowledge-based resources**, particularly in science and technology, and by sustaining the most fertile environment for new and revitalized industries and well-paying jobs.”

# Call For Action

- \* Here we focus on those scientists and engineers who are key to the continuing strength of the S&E enterprise
  - individuals with doctoral degrees in the natural sciences
    - life, physical, and mathematical/computer sciences (as well as individuals in the life sciences possessing medical degrees).
  - and engineers who have at least baccalaureate degrees.
- \* This is termed the NS&E labor force.

# Defining the NS&E Workforce

- \* Can use field of degree, occupational field, or some combination of the two.
- \* Data from the National Science Foundation's *Scientists and Engineers Data System* (SESTAT), namely, the *National Survey of College Graduates, 2003*.

# Defining the NS&E Workforce

\* Several advantages over alternative data sources:

- Includes information on field of degree.
- Includes talent from abroad who have not subsequently received at least a baccalaureate degree in the U.S.
- Includes individuals whose highest degree is a medical degree.

# NS&E labor markets

- \* Three snapshots of NS&E markets.
  - The first focuses on diversity in terms of gender, ethnicity, and nativity-immigrant status.
  - The second focuses on workforce status.
  - The third on workforce status in greater detail, and on employment in industry.

**Table 1. Natural Science & Engineering (NS&E) Labor Force by Field of Education, 2003**

	ALL NS&E	Math/Comp. Sciences	Life Sciences	Physical Sciences	Engineering Sciences
<b>Total</b>	2,809,547 100.0%	62,837 2.2%	227,698 8.1%	151,201 5.4%	2,367,810 84.3%
Female	14.8%	22.8%	33.1%	15.1%	12.1%
Black, non-hispanic	3.2%	4.7%	3.4%	1.7%	3.2%
Hispanic, any race	5.4%	3.6%	3.9%	3.0%	5.7%
Other URM	1.6%	0.7%	1.5%	0.5%	1.8%
Foreign Born	28.7%	49.7%	34.8%	35.2%	27.2%
Non-US citizen, perm. resident	8.4%	19.5%	12.0%	11.5%	7.5%
Non-US citizen, temp. resident	3.8%	8.1%	6.5%	5.7%	3.3%

Author's calculations using the 2003 NSCG. Excludes individuals in the military and those with age > 65. Excludes those without a doctorate (or MD in the life sciences) in the natural sciences and those without at least a baccalaureate degree in the engineering sciences. Other URM includes other underrepresented minorities including those reporting multiple races.

**Table 2. Workforce status of those educated in NS&E disciplines, 2003**

	ALL NS&E	Math/Comp. Sciences	Life Sciences	Physical Sciences	Engineering Sciences
<b>Total</b>	2,809,547 100.0%	62,837 2.2%	227,698 8.1%	151,201 5.4%	2,367,810 84.3%
<b>Sector</b>					
Academe	9.0%	50.6%	44.9%	30.2%	3.1%
Industry	54.4%	26.7%	22.0%	37.1%	64.6%
<b>Employed</b>					
NS&E occupations	57.2%	76.5%	61.4%	69.0%	55.5%
S&E related occupations	8.2%	4.4%	14.9%	5.9%	7.7%
Non-S&E occupations	24.1%	13.0%	15.1%	16.3%	25.8%
<b>Not working</b>					
Unemployed	3.9%	1.9%	3.9%	3.4%	3.9%
Out Labor Force	6.7%	4.3%	4.7%	5.3%	7.0%

Author's calculations using the 2003 NSCG. Excludes individuals in the military and those with age > 65. Excludes those without a doctorate (or MD in the life sciences) in the natural sciences and those without at least a baccalaureate degree in the engineering sciences. Academe includes 4-year colleges or universities, medical schools and university research institutes.

**Table 3. Workforce status and industrial employment,  
by field of education, 2003**

**Mathematical and Computer Sciences**

<b>Total educated in field</b>	62,837
<b>Employment status</b>	
Same field as training	72.1%
Other NS&E occupation	4.4%
S&E-related occupation	4.4%
Non-S&E occupations	13.0%
Unemployed	1.9%
Out Labor Force	4.3%
Working part-time	2.9%
Involuntarily part-time	<i>n</i>
<b>Total employed in industry</b>	16,789
Computer systems design & related services	27.9%
Scientific research & development services	11.7%
Computer & peripheral equipment manuf.	7.6%
Electronic component & product manuf., n.e.c.	6.7%
Wired telecommunication carriers	6.7%

## Life Sciences

**Total educated in field** 227,698

### Employment status

Same field as training 54.8%

Other NS&E occupation 6.6%

S&E-related occupation 14.9%

Non-S&E occupations 15.1%

Unemployed 3.9%

Out Labor Force 4.7%

Working part-time 5.1%

Involuntarily part-time 0.5%

**Total employed in industry** 49,993

Scientific research & development services 33.5%

Pharmaceutical & medicine manuf. 15.8%

Other health care services 5.2%

Medical equipment & supplies manuf. 3.6%

Architectural, engineering & rel. services 3.5%

## Physical Sciences

**Total educated in field** 151,201

### **Employment status**

Same field as training 48.7%

Other NS&E occupation 20.3%

S&E-related occupation 5.9%

Non-S&E occupations 16.3%

Unemployed 3.4%

Out Labor Force 5.3%

Working part-time 2.9%

    Involuntarily part-time 0.3%

**Total employed in industry** 56,150

Scientific research & development services 19.8%

Pharmaceutical & medicine manuf. 12.1%

Industrial & Miscellaneous chemicals 8.2%

Electronic component & product manuf., n.e.c. 4.8%

Computer systems design & related services 4.7%

## Engineering Sciences

**Total educated in field** 2,367,810

### Employment status

Same field as training 42.7%

Other NS&E occupation 12.8%

S&E-related occupation 7.7%

Non-S&E occupations 25.8%

Unemployed 3.9%

Out Labor Force 7.0%

Working part-time 3.7%

Involuntarily part-time 0.6%

**Total employed in industry** 1,424,741

Architectural, engineering & related services 13.4%

Computer systems design & related services 8.1%

Electronic component & product manuf., n.e.c. 5.9%

Construction 5.6%

Motor vehicle & motor vehicle equip. manuf. 4.1%

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Author's calculations using the 2003 NSCG. If unweighted cell count <6 then result is not reported and indicated by *n*.

# Key Features

1. Knowledge acquired in NS&E fields more so than in other fields, is subject to obsolescence, especially when major breakthroughs occur.

ü **IMPLICATIONS:** Enduring spells out of the labor force will be more costly in some scientific fields than others; plays a role in occupational choice and exit decisions. Women more likely affected than men.

# Key Features

2. The knowledge spillovers from R&D are important to a country's economic growth and prosperity. Tacit knowledge, which is embodied in the know-how of a scientist, does not spill over to other countries unless the scientist migrates.

# Key Features

üIMPLICATIONS: The competitive strength of a country's scientific enterprise matters not only in terms of achieving first-mover advantage, but also from the benefits of increasing returns that stem from knowledge spillovers. Other countries benefit from the migration of scientists and engineers trained in the U.S.

# Key Features

3. The time necessary to become an independent investigator in most disciplines in the natural sciences is very long compared to the time necessary to establish careers in medicine, law or business. Lifetime earnings do not, on average, compensate for the longer time period of investment.

# Key Features

üIMPLICATIONS: High opportunity costs of careers in NS&E lead talented Americans to pursue careers in other fields. Foreign talent is not similarly discouraged.

# Key Features

4. Federal research funding initiatives and immigration policies affect both S&D in S&E markets.

4a. S&E labor markets are often subject to large fluctuations in research funding.

# Key Features

ü **IMPLICATIONS:** Funding growth typically translates into growth in the number of new “slots” for doctoral students and postdocs, not necessarily into new career positions, especially in academe. Subsequent funding slowdowns mean that more researchers are competing for increasingly tighter funds.

# Key Features

4b. Immigration policy also affects S&E labor markets.

- In the short-run, H1-B visas.
- In the longer term, foreign talent has played an important role in U.S. science.

# Key Features

üIMPLICATIONS: “By increasing the number of scientists and engineers, highly populous countries such as China and India can compete with the U.S. in technically advanced industries, even though S&E workers are a small proportion of their work forces (Freeman, 2005).” The U.S. may experience a “reverse” brain-drain.