The Shortage of STEM Skills

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Three Approaches to Defining Shortage

Academic definitions of shortage by Nobel-prize winning economists:

1. David Blank and George Stigler (1957): A shortage is indicated by an increase in relative wages

2. Kenneth Arrow and William Capron (1959): A “dynamic” shortage is indicated by unfilled vacancies, even if wages don’t increase

Intuitive non-academic definition:

3. Workers who get the skills that are in shortage tend to be better off (in terms of employment opportunities and earnings) than those who do not

STEM skills are in shortage by all three definitions.
1. Are Relative Wages for STEM Growing?
Earnings Premium for STEM Skills, Controlling for Experience, Education, and Sex, 1950-2012

Source Analysis of Census data from IPUMS, using ONET skill data, Version 18. See “Hidden STEM Economy”
Relative Earnings are Growing for Computer Workers and Engineers

Median Wages of College Educated Computer and Engineering Workers Relative to all Workers, 2000-2012

STEM Majors are Seeing higher Earnings Growth: Growth in total earnings of young adults aged 21-30 by bachelor's level field of study, 2009-2012

Source: 2009 and 2012 U.S. Census Bureau’s American Community Survey, via IPUMS, 1% Sample of U.S. Population
What about longer-term wages for “IT” occupations?

For IT workers, “Wages have remained flat, with real wages hovering around their late 1990s levels.”
-From Salzman et al

“Guestworkers in the High-skill U.S. Labormarket: An Analysis of Supply, Employment, And Wage Trends”
Actually, wages for computer workers have increased since 1990, and the only group of computer workers with flat wages since 2000 were those whose graduate educational requirements fell, as millions of new computer jobs were created.

<table>
<thead>
<tr>
<th>Year</th>
<th>Workers in occupation</th>
<th>Inflation adjusted earnings</th>
<th>Share of workers with at least bachelor's degree</th>
<th>Share of workers with graduate level education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Computer software developers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>337,149</td>
<td>$48,327</td>
<td>49%</td>
<td>15%</td>
</tr>
<tr>
<td>1990</td>
<td>590,031</td>
<td>$53,922</td>
<td>56%</td>
<td>15%</td>
</tr>
<tr>
<td>2000</td>
<td>671,949</td>
<td>$65,167</td>
<td>64%</td>
<td>16%</td>
</tr>
<tr>
<td>2013</td>
<td>1,718,899</td>
<td>$82,215</td>
<td>78%</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td><strong>Computer systems analysts and computer scientists</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>231,748</td>
<td>$60,729</td>
<td>62%</td>
<td>27%</td>
</tr>
<tr>
<td>1990</td>
<td>649,368</td>
<td>$60,804</td>
<td>65%</td>
<td>22%</td>
</tr>
<tr>
<td>2000</td>
<td>1,694,770</td>
<td>$71,825</td>
<td>67%</td>
<td>17%</td>
</tr>
<tr>
<td>2013</td>
<td>1,911,566</td>
<td>$67,976</td>
<td>60%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Source: Analysis of U.S. Current Population Survey, March Supplement, via Integrated Publicuse Microdata Series (IPUMS). IPUMS "Occ1990" categories all modern day computer occupations (from the 2013 CPS) into one of the two categories listed above retrospectively through the years listed.
1. Relative Wages are Growing.
2. Are STEM Vacancies More Likely to go Unfilled?
Difficulty of Filling Job Vacancies in Largest Metropolitan Areas by Occupational Category, 3-month average 2006-Q4 to 2012-Q1

- Healthcare
- Science, Technology, and Engineering
- Management, Business, Legal, and Design
- Public Service
- Construction, Production, Transportation, Repair

Source: Conference Board, HWOL Series
Job vacancies per unemployed worker, January 2014

- Computer and mathematical science: 5.0
- Healthcare practitioners and technical: 3.3
- Architecture and engineering: 1.7
- Life, physical, and social science: 1.1
- Business and financial operations: 1.0
- Management: 1.0
- Installation, maintenance, and repair: 0.8
- Legal: 0.7
- Community and social services: 0.7
- Arts, design, entertainment, sports, and media: 0.6
- Sales and related: 0.6
- Healthcare support: 0.6
- Education, training, and library: 0.5
- Office and administrative support: 0.4
- Transportation and material moving: 0.4
- Protective service: 0.3
- Food preparation and serving related: 0.3
- Production: 0.2
- Personal care and service: 0.2
- Building and grounds cleaning and maintenance: 0.1
- Construction and extraction: 0.1
- Farming, fishing, and forestry: 0.1

Source: Conference Board, HWOL Series
2013-Q1 job openings advertised for at least 60 days on company websites by selected occupations

- Computer and Mathematical: 49,744
- Healthcare Practitioners and Technical: 46,983
- Management: 36,027
- Business and Financial Operations: 26,516
- Architecture and Engineering: 16,039
- Life, Physical, and Social Science: 4,532
- Arts, Design, Entertainment, Sports, and Media: 4,278
- Legal: 978

Source: Analysis of data compiled for Burning Glass. Sample excludes job boards and is only for ads first posted between Jan-March of 2013.
2. STEM
Vacancies are more likely to go unfilled.
3. Does STEM Knowledge make workers better off economically?
Unemployment rates for STEM occupations are at or below average since 2000 and far below U.S. rate

Unemployment rates for STEM occupations have been consistently lower than the U.S. average since 2000, reaching a record low of 3.6% in 1970. Since 2013, unemployment rates for STEM occupations have been below 3.5%, compared to the 6.7% current U.S. unemployment rate.

STEM Grads are Highest Paid:
Salaries of Recent Graduates Aged 21-30 in Most Popular Majors, 2012

Source: 2012 American Community Survey, via IPUMS. Majors with 1 million or more population.
**Occupations of computer science bachelor's degree holders for all groups with at least one percent of computer science degree holders, 2012**

<table>
<thead>
<tr>
<th>Minor Occupation</th>
<th>Share of computer science degree holders</th>
<th>Average earnings</th>
<th>Standardized Score for Computer Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Occupations</td>
<td>47.4%</td>
<td>$81,678</td>
<td>2.6</td>
</tr>
<tr>
<td>Operations Specialties Managers</td>
<td>6.9%</td>
<td>$110,279</td>
<td>1.9</td>
</tr>
<tr>
<td>Other Management Occupations</td>
<td>6.9%</td>
<td>$98,811</td>
<td>0.7</td>
</tr>
<tr>
<td>Business Operations Specialists</td>
<td>3.5%</td>
<td>$85,583</td>
<td>1.0</td>
</tr>
<tr>
<td>Engineers</td>
<td>2.5%</td>
<td>$98,660</td>
<td>1.8</td>
</tr>
<tr>
<td>Financial Specialists</td>
<td>2.0%</td>
<td>$63,887</td>
<td>1.0</td>
</tr>
<tr>
<td>Top Executives</td>
<td>1.9%</td>
<td>$152,833</td>
<td>0.8</td>
</tr>
<tr>
<td>Postsecondary Teachers</td>
<td>1.6%</td>
<td>$54,071</td>
<td>0.9</td>
</tr>
<tr>
<td>Supervisors of Sales Workers</td>
<td>1.6%</td>
<td>$87,280</td>
<td>0.0</td>
</tr>
<tr>
<td>Electrical and Electronic Equipment Mechanics, Installers, and Repairers</td>
<td>1.5%</td>
<td>$49,748</td>
<td>2.1</td>
</tr>
<tr>
<td>Other Office and Administrative Support Workers</td>
<td>1.4%</td>
<td>$49,686</td>
<td>1.0</td>
</tr>
<tr>
<td>Information and Record Clerks</td>
<td>1.3%</td>
<td>$44,444</td>
<td>0.0</td>
</tr>
<tr>
<td>Preschool, Primary, Secondary, and Special Education School Teachers</td>
<td>1.2%</td>
<td>$40,842</td>
<td>0.8</td>
</tr>
<tr>
<td>Retail Sales Workers</td>
<td>1.1%</td>
<td>$51,075</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Analysis of 2012 American Community Survey via Integrated Public Use Microdata Series (IPUMS). Computer knowledge requirements are from O*NET survey data using 6-digit level occupations.
Shortage Criteria 3

3. STEM Knowledge benefits workers.