Hard Times for Computer Science:
An Economist's Examination and Analysis of the Rise and Fall of Computer Science as a Super Major in the U.S.
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I. Introduction

During the latter half of the 1990s, there was a rise in the number of computer-related jobs demanded by U.S. employers. From 1999 to 2000 alone there was a 14% increase in the combined number of Computer Programmers and Software Engineers for the Systems and Applications software sectors (see Table 1).

Table 1: \*avg. of spring and fall data

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003*</th>
<th>2004*</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Programmers</td>
<td>528,600</td>
<td>530,730</td>
<td>501,550</td>
<td>457,320</td>
<td>417,430</td>
<td>404,095</td>
<td>389,090</td>
</tr>
<tr>
<td>Computer Software Engineers, Applications</td>
<td>287,600</td>
<td>374,640</td>
<td>361,690</td>
<td>356,760</td>
<td>401,360</td>
<td>432,805</td>
<td>455,980</td>
</tr>
<tr>
<td>Computer Software Engineers, Systems Software</td>
<td>209,030</td>
<td>264,610</td>
<td>261,520</td>
<td>255,040</td>
<td>289,140</td>
<td>319,570</td>
<td>320,720</td>
</tr>
<tr>
<td>Total</td>
<td>1,025,230</td>
<td>1,169,980</td>
<td>1,124,760</td>
<td>1,069,120</td>
<td>1,107,930</td>
<td>1,156,470</td>
<td>1,165,790</td>
</tr>
</tbody>
</table>

Demand was so great that in 2000 alone, 2,378 college grads were hired by the Intel Corporation. These were not just run of the mill entry jobs, either. In some cases, computer science students were being offered monetary incentives to drop out of school and get behind corporate keyboards. Some had ten job offers to sift through upon graduation day. Résumés were optional (Hafner).

Students responded to this incredible demand by increasing their enrollment in CS programs across the country. Beginning-level computer science classes at UC Berkeley had as many as 700 students enrolled. “Enrollment in computer science departments nearly doubled between 1995 and 2000.” (Hafner). Changes were not far around the corner, however.

There was a sudden drop in CS enrollment during the first few years of the 2000s-so much, in fact, that total enrollment numbers fell by 30% (Chabrow). For example, a mere 350 students elected to take the UC Berkeley elementary CS course in the spring of 2003 (Hafner). The supply of CS students was dropping, but why? Pay was not decreasing significantly.
In fact, pay was increasing (see Figure 1). While $28.29/hr may not be a stellar wage rate, the potential to earn over $58k per year is definitely more than the average social science baccalaureate sees upon graduation. Be that as it may, it seems that cash in the bank is not good enough for the contemporary student. Again one must ask the question—Why?

Figure 1: 1999 Base Year CS Salaries

II. Economic Analysis

Analyzing the CS labor market, one first notices something peculiar about the supply and demand situation (see Figure 2). Firstly one sees that the demand for CS labor in terms of additional CS workers added to the market is actually negative from a wage of slightly more than $27.50/hr down to a wage of $25.50/hr. Were the folks working at this wage laid off?

In attempting to answer this question one might also see that a similarly peculiar CS labor supply curve develops from each year’s newly-declared CS majors. Indeed fewer students majored in CS even as wages in the field increased.

When one examines the salary data for the market, however, he’ll find that real CS wages have increased annually since 1999 (when using 1999 as the base year—see Figure 1). Thus the wages here are also linked to a progression of time. What, then, happened between 1999 and 2005 that could have caused a negative demand and a downward-sloping supply curve?
It just so happens that the period of negative demand that lies between the $25.50 and $27.50/hr is a characteristic of the period of time between these two wage rates. After the "tech bubble" burst early in the decade and the U.S. entered a period of recession, the demand for internet-savvy computer programmers fell.

**Figure 2**

Additionally, some jobs were off-shored to the cheaper Asian labor markets. There were thus many layoffs, which are represented by the negative demand for new workers in the CS market. The quirky CS labor supply curve is the result of a related set of circumstances.

When students examine salaries for post-grad jobs with the intent of picking a major, they evidently do not simply examine the median salaries for jobs related to the major(s) they are considering. Job security or the "layoff risk" for a particular field is, in this case, considered to be a part of compensation. Taking this factor into account, the fall in CS enrollment despite the higher wages suddenly makes sense.

This perception of poor job security for CS-related careers drove many away from the field (see Figure 3). Further reducing the appeal of CS as a major is the highly abstract nature of the discipline, which requires a strong background in theoretical mathematics. There were a number of students who
changed majors after weighing the difficulty of the studies and the slim job prospects against what seemed to have been good initial salary offerings (Hafner). Many of these students left for what became the new “hot” fields, which because of “the popularity of criminal forensic shows such as CSI and Crossing Jordan,” turned out to be biology, chemistry, and criminal justice (Chabrow).

Figure 3

The perceived lack of job security for IT workers combined with a growing sense of dissatisfaction among computer science students who chose their major for its appealing earnings potential rather than their own personal interest led to computer science’s demise as America’s major of choice.

III. Data Description

a. Demand Curve

The demand curve (see Figure 2) for CS workers used for the purpose of this analysis was derived by 1) calculating the annual difference between total CS workers employed for years 1999-2005.
(see Table 1) and 2) plotting these differences against the real wage for each year (see Figure 1). The three specific employment numbers used to obtain the total amount of CS workers for each year were chosen because they were the CS-related jobs for which statistics were available. Differences were employed (as opposed to total annual employment) because they best tell the analyst about the market’s situation, i.e. whether or not companies were hiring or laying off workers at a particular wage level.

b. Supply Curve

The supply curve (see Figure 2) for the CS labor market was derived by examining the number of newly-enrolled CS students in college departments across the country for each year and then plotting these differences against the real wage for each year. The data set is limited to PhD-granting institutions because the survey that generated this data was so limited. Thus total enrollment numbers are lower than if all institutions with CS programs were to be included. Nevertheless, this data was the most recent, which is why it was chosen for this analysis. Additionally, “the percentage of incoming undergraduates among all degree-granting institutions who indicated they would major in CS declined by 70 percent between fall 2000 and 2005,” which certainly reinforces the PhD-granting institutions’ numbers (Vegso).

c. Salary Data

Salary data for this analysis is the result of the average of the wages for two fields as maintained by the U.S. Bureau of Labor Statistics (BLS): Computer Programmers and Computer Systems Analysts & Scientists. The averages were then used to calculate real wages for each year following 1999. This base year was chosen because it is in fact the base year for this report, and it was desirable in terms of analysis to determine exactly how much salaries have changed since 1999.

d. Layoff Data

Data here were obtained from the BLS. Major layoff events for specific sectors are recorded by the BLS. The BLS-monitored sector that relates most closely to the subject of this analysis is the IT sector. Thus the layoff data is for the IT sector as a whole.

IV. Conclusion

Computer Science as a field of study is far from disappearing from the offerings of American colleges. There is still a demand for computer scientists. The BLS is predicting a need for hundreds of
thousands of additional CS-related workers. Furthermore, “every [technological] advance that [one] can anticipate…[will]…require software that has not yet been written.” (Chabrow).

It thus seems that student response to the change in demand for CS workers was a bit over reactive. There are still good CS-related jobs in the market. For instance, Computer Software Engineers for both applications and systems software are now in higher demand than they were in 2000. Only programmers—which comprise the entry level CS positions—seem to have been affected by the layoffs (see Table 1). It seems that programmer layoffs are a result of the combined effects of domestically-induced factors (i.e. the post-millennial recession and the bursting of the “tech bubble”) and increasingly-tempting cheap offshore labor.

The present market, nonetheless, is undoubtedly better for the field of computer science and for the IT industry as a whole. Employers are demanding high-quality software engineers and are paying them more money than ever. Intel and IBM have both reached out to potential students through their large corporate outreach programs (Hafner). Meanwhile, the supply of computer science students is being enriched.

Gone are the days of CS departments wasting their time and resources on students (such as the author of this paper) whom populated departmental courses because they had a get-rich-quick fantasy rather than a love for computing and programming. Students today are more interested in computers and programming than were the masses of five years ago. “They aren’t looking to become millionaires by age 25.” (Hafner).

In essence, what can be observed is a higher-quality supply of CS workers entering higher-paying IT jobs. Additionally, ex and would-be CS students are entering fields where their new skills in their chosen fields will (hopefully) be put to better use because of their true interest in the field (rather than an infatuation with their paychecks). Thus market forces have (once again) improved the productivity of society—and the lives of many people.
References


Data Sources

CPI Data: <http://www.bls.gov>

CS Enrollment (supply) information: <http://www.cra.org/CRN/articles/march06/vegso.html> and: <http://www.cra.org/statistics/>


IT Layoff Data: <http://www.bls.gov/opub/ted/2004/may/wk4/art02.txt>