

## The Surprising Impact of High School Math on Job Market Outcomes

*Jon James*

The economic returns to education are well documented. It is also well-known that college graduates with certain majors will earn more than others and find it easier to land a job. But surprisingly, the courses students take in high school also make a difference, when the courses are mathematics. Even among workers with the same level of education, those with more math have higher wages on average and are less likely to be unemployed. These findings suggest that even students ending their formal education after high school can increase their future earnings by investing in more math courses while in high school.

High school graduates earn more money in general than high school dropouts. This well-known fact is a powerful incentive to finish high school. But is it just the diploma that counts, or do the particular courses students take while in high school matter for their future job prospects? Students can opt for a variety of courses, from vocational tracks to advanced placement classes for college credit, during their final four years of required education.

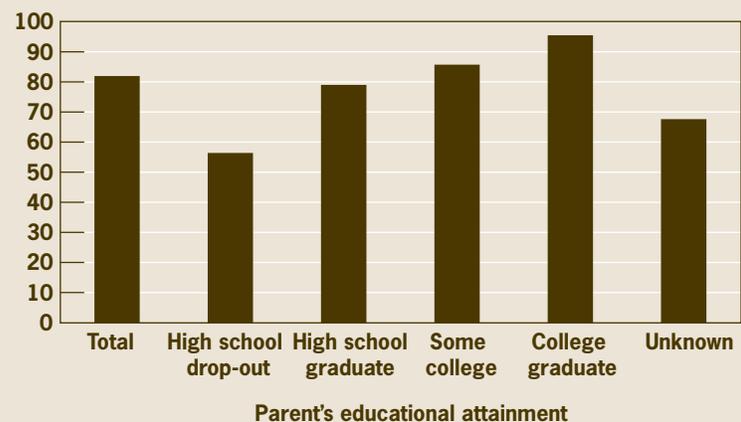
Most high school graduates choose a curriculum that is far more rigorous than the minimum requirements. This is most evident in mathematics courses. For example, in 2009, 75 percent of high school graduates completed math coursework at the level of Algebra II or above. Most of these students could have stopped at Algebra I and satisfied the minimum high school requirements. Only six states required Algebra II for graduation as of 2006. About 11 required Algebra I, six required geometry, and the remaining 27 required only that students complete a minimum of three years of mathematics at any level.

The fact that so many students take a rigorous math curriculum is not surprising given that a minimum of Algebra II is necessary for adequate college preparation. But an analysis of detailed high school transcript data and employment outcomes suggests that a more rigorous high school math curriculum benefits even those who do not go to college. While math may be difficult for many, our findings indicate that the payoffs for all students may be substantial.

### Math and Educational Attainment

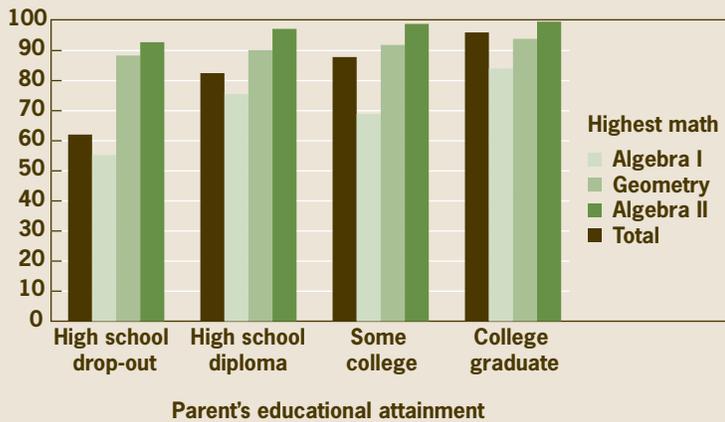
For better or for worse, many outcomes for an individual in life are closely related to the outcomes of their parents. This fact is particularly true for educational attainment (figure 1). Students whose parents did not finish high school have less than a 60 percent chance of completing high school themselves. By contrast, a student whose parents have a high school degree and no college has almost an 80 percent chance of completing high school, and a child of a college-degree holder has a 95 percent chance of finishing high school.

**Figure 1. Share of 20-Year Olds Who Have Completed High School, by Parent's Educational Attainment**



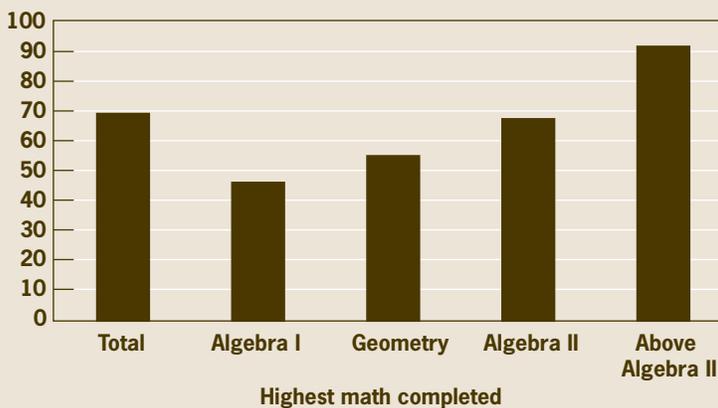
Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

**Figure 2. Share of Students Completing High School, by Parent's Educational Attainment and Highest Math Completed**



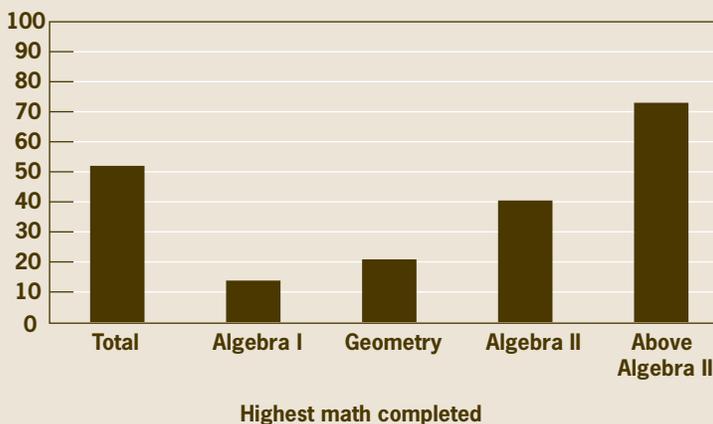
Note: Does not include students who dropped out prior to ninth grade.  
Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

**Figure 3. Share of High School Graduates Ever Attending College, by Highest High School Math Completed**



Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

**Figure 4. Share Ever Attending College That Complete a Four-Year Degree, by Highest High School Math Completed**



Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

However, one's family background may not be the strongest predictor of high school completion. A potentially better predictor is math.

Among students who have at least completed the ninth grade, the child of a college graduate is 50 percent more likely to graduate high school than a child of a high school dropout (figure 2). For students who have completed geometry or above, this difference shrinks dramatically, with children of college graduates being only 6 percent more likely than children of high school dropouts to obtain a high school diploma.

For those who obtain a high school diploma, the mathematics curriculum taken in high school is strongly related to whether they will attend college. This is not surprising, given that while most high schools do not have specific course requirements to graduate, most colleges do have specific course requirements for admittance.

Nonetheless, a sizeable 50 percent of high school graduates who have at most Algebra I will attend college (figure 3). These students are the least likely to finish college, with only 13 percent going on to complete a four-year degree (figure 4). By contrast, not only are those with Algebra II more likely to go to college at 68 percent, but more importantly, they are three times more likely to earn a four-year degree, with a 40 percent completion rate.

Whether a more rigorous math background in high school increases educational attainment because it directly satisfies admission requirements to college or because it prepares students better to succeed there, it clearly facilitates future educational investments. Not only does it increase one's chance of completing high school, perhaps more importantly, it also increases the chances of attending and completing college.

Unfortunately for those students who are unsure of whether they want to go to college, taking too little math in high school may substantially reduce their chance of success if they do decide to go later. On the other hand, students who plan only to finish high school, but who take additional math, may be very glad if their educational aspirations change down the road.

### Math and Labor Market Outcomes

Clearly, math attainment is strongly related to educational attainment. And because those with higher education do better in the labor market, the correlation provides an indirect channel through which mathematics improves labor market outcomes.

However, even within any given level of educational achievement, there are large differences in the amount of math completed in high school (figure 5). For example, among high school graduates, about 25 percent have Pre-Algebra or Algebra I, 22 percent have geometry, and 33 percent have Algebra II. It would be helpful to know whether higher math achievement confers any benefits to workers, beyond the fact that it may have made them more likely to graduate high school or college.

It does. The more math one takes, the more one earns on average, and the more likely one is to have a job (figures 6 and 7). The median wage for full-time workers aged 20-30 who dropped out of high school after completing only Pre-Algebra, Algebra I, or less is \$12.70 per hour. In contrast, dropouts with geometry or Algebra II have a significantly higher median hourly wage of \$14.36. Likewise, the unemployment rate for dropouts with less math is 33 percent, while for dropouts with more math, it is 27 percent. (Unemployment is defined as those not enrolled in school or working either part-time or full-time.) About 75 percent of high school dropouts are in the low-math category.

A similar pattern exists for those who graduated high school but did not attend college (figure 7). Those with low levels of math are 50 percent more likely to be unemployed than those with higher levels of math. They typically earn about \$1.30 less per hour. About 34 percent of workers who completed high school but no college coursework are in the low-math category, and 55 percent are in the high-math category. The remaining 10 percent had higher than Algebra II and are not included in this analysis.

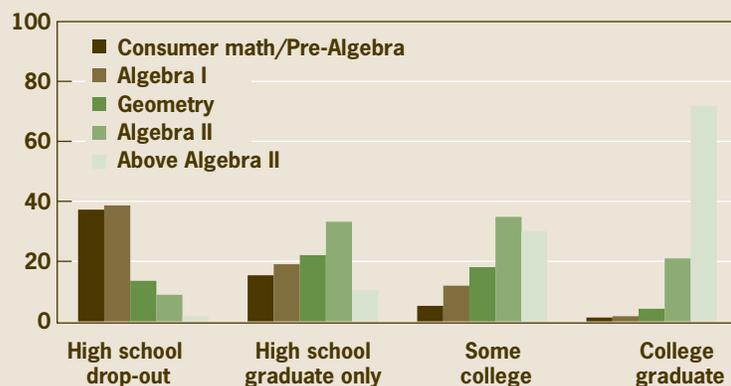
For both high school dropouts and high school graduates, higher levels of math lead to substantially better labor market outcomes, with increased levels of employment and increased earnings. Interestingly, the earnings differential between high school graduates with high and low math is about 10 percent, about the return to one year of college. Put another way, students who find college prohibitively costly can potentially increase their earnings by making smarter choices while in high school, an institution with zero monetary costs.

One concern with any analysis of the returns to an educational input is determining whether there is really a cause-and-effect relationship. In this case, for example, the correlation between math and labor market outcomes could reflect the fact that taking more rigorous math courses causes an increase in wages. Or it could be that these results simply reflect other differences not accounted for in the analysis. These concerns are greatest when one compares groups that are too different, say, high school dropouts and college graduates. Since this analysis compares relatively similar groups of workers (such as only high school dropouts), it is likely that the effects of unaccounted-for variables is less of an issue. Other work (such as Rose and Betts 2004), which studies the causal return to high school math using more sophisticated methods, finds similar results to the ones presented here.

### Still More Math?

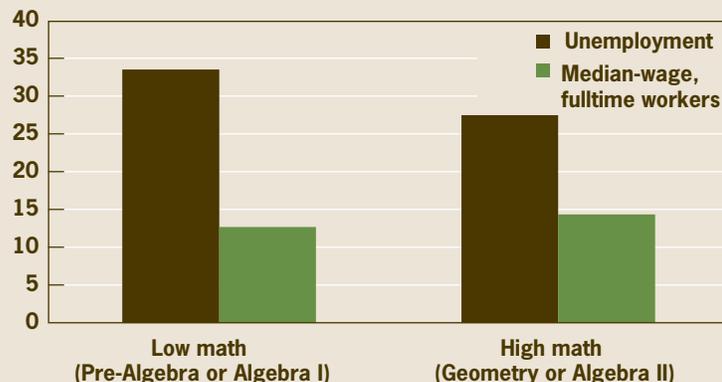
Over the last three decades there have been substantial changes in the course requirements for high school students. These changes have emphasized more rigorous math requirements in order to prepare students better for a postsecondary education. The result of this emphasis is striking. In 1982, 39 percent of high school graduates had completed Algebra II or higher. In 2009, this number is almost double at 75 percent.

**Figure 5. Highest Math Completed, by Educational Attainment**



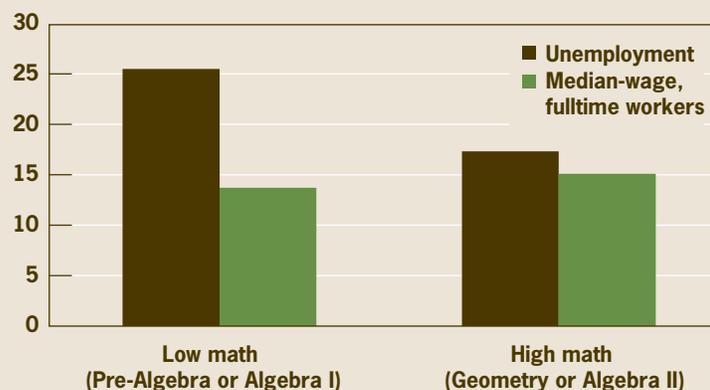
Note: Includes those with at least one high school math credit.  
Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

**Figure 6. Labor Market Outcomes of High School Drop-Outs, by Highest Math Completed**



Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.

**Figure 7. Labor Market Outcomes of High School Graduates**



Source: Bureau of Labor Statistics, National Longitudinal Survey of Youth 1997.



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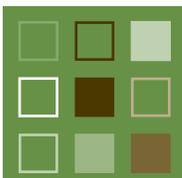
Given the strong evidence that high school math courses can have a very positive effect on a worker's labor market outcomes, these changing standards seem a move in the right direction. However, students may well wonder, if the payoffs to math are so large, why stop at the minimum standards?

### Further Reading

"Who goes to college? Evidence from the NLSY97," Alison Aughinbaugh, 2008. *Monthly Labor Review*.

"Math Matters: The Links Between High School Curriculum, College Graduation, and Earnings," Heather Rose and Julian R. Betts, 2001. *Public Policy Institute of California*.

"The Effect of High School Courses on Earnings," Heather Rose and Julian R. Betts, 2004. *The Review of Economics and Statistics*, May.



Jon James is a former research economist at the Federal Reserve Bank of Cleveland. The views he expresses here are his and not necessarily those of the Federal Reserve Bank of Cleveland, the Board of Governors of the Federal Reserve System, or Board staff.

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