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RESEARCH BRIEF
APRIL 2024

HOW HIGH SCHOOL COMPUTER SCIENCE COURSES AFFECT COLLEGE MAJORS AND EARLY-CAREER EARNINGS

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CENTRAL QUESTION

Do state policies requiring high schools to offer computer science (CS) coursework boost students' CS degree attainment and earnings? Can these policies increase access to CS for underrepresented students?

Employment in computer and information technology occupations is projected to grow by 10% in the next decade.[1] In response to rising demand for technology skills, many states are expanding K-12 CS learning opportunities. Thirty states have adopted "CS for All'' policies, which require all high schools to offer CS coursework, while eight require all students to take CS prior to high school graduation.[2] Despite this heightened policy interest in CS access, little evidence exists on how CS expansion affects postsecondary and labor market outcomes as well as CS course take-up.

This brief investigates the impact of high school CS expansion in Maryland—a state that has rapidly expanded CS course offerings over the last decade. A 2018 law further requires all Maryland high schools to offer at least one "high-quality" CS course aligned with rigorous K-12 CS standards, including foundational courses such as Computer Science Essentials, AP courses such as AP Computer Science Principles, and specialized programming courses. These courses are closely aligned with Code.org's definition of "foundational" CS courses.[1]

Using rich longitudinal data from the Maryland Longitudinal Data System (MLDS) Center, we present the first causal evidence on how access to "high-quality" CS courses affects college major choice, early-career earnings, and high school CS course-taking.

KEY FINDINGS

Exposure to high school CS coursework raises CS BA receipt and improves early-career labor market outcomes.

Figure 1A: Effects of CS Course-Taking on BA Degree Field

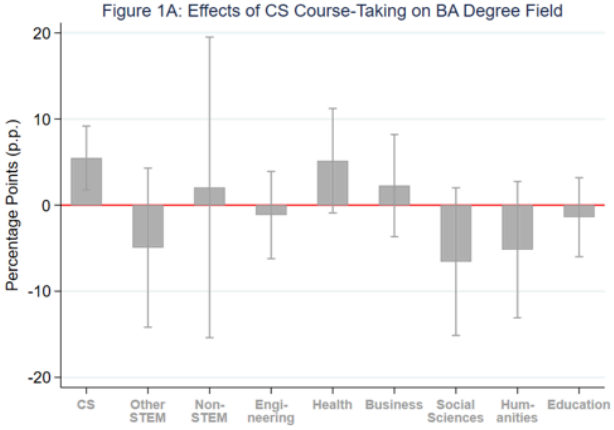


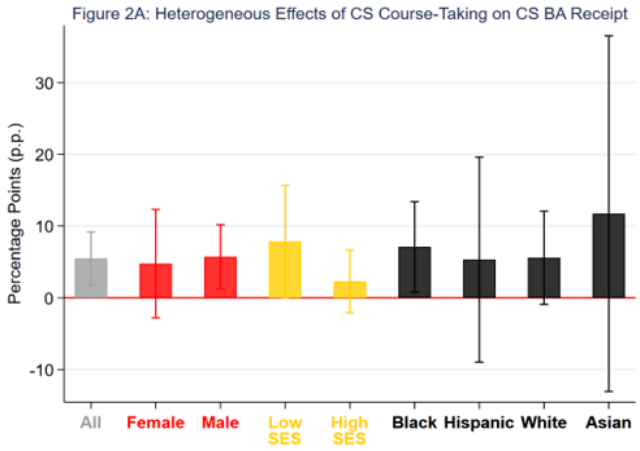
Figure 1B: Effects of CS Course Offering on Employment and Earnings

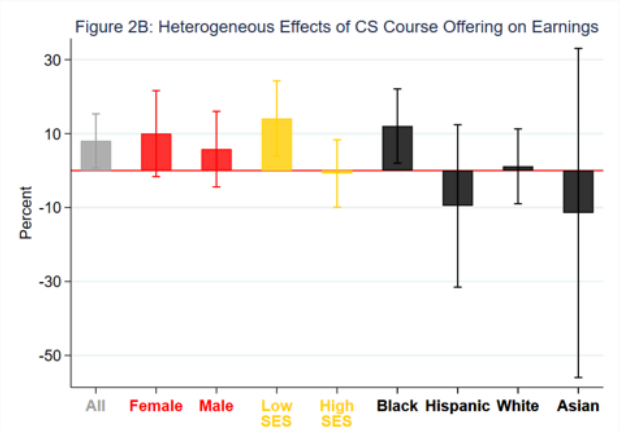
Taking a high school CS course leads to a 5 percentage point increase in students' likelihood of earning a Bachelor of Arts (BA) in CS (Figure 1A). Negative effects for other STEM fields, social sciences, and humanities

About this Brief. The University of Maryland College of Education's **Maryland Equity Project (MEP)** seeks to improve public education through research that supports an informed public policy debate about the quality and distribution of educational opportunities in Maryland and nationally. To learn more, **follow us on X** and **subscribe to our email list**. A version of this brief is published on the **Brown Center Chalkboard**. The full academic paper accompanying this brief is posted on our website: Liu, Jing, Cameron Conrad, and David Blazar. (2024). ***Computer Science for All? The Impact of High School Computer Science Courses on College Majors and Earnings***.

suggest students may be switching from these fields to CS. We also find positive impacts on employment and earnings at age 24: high schools offering CS raise students' likelihood of being employed by 2.6 percentage points and annual earnings by about 8% (Figure 1B).

Effects on CS BA receipt and earnings are similar or larger for students historically underrepresented in CS.

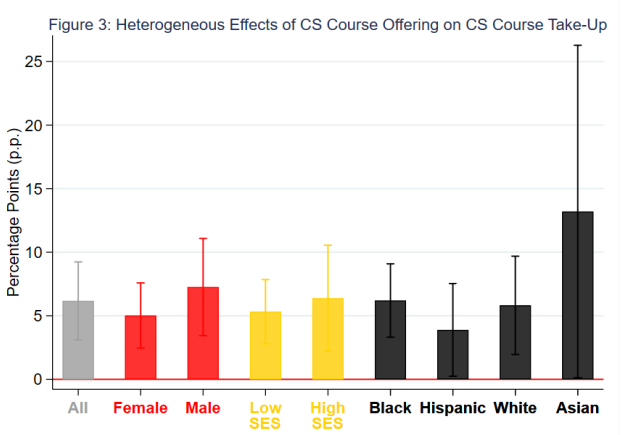




High school CS course-taking has similar or larger effects for females, students from lower socioeconomic status (SES) backgrounds, and Black students relative to peer groups historically better represented in CS fields. Taking a CS course raises CS BA receipt by nearly 8 percentage points for low SES students and by 7 percentage points for Black students (Figure 2A). Consistent with the heterogeneity results for CS BA receipt, we find that high schools offering CS coursework increase earnings at age 24 by 10-14% for students who are female, low SES, or Black (Figure 2B). Together, these findings suggest that exposing students to CS coursework in high school could increase the supply of CS degree recipients and professionals in the labor market, particularly for historically underrepresented groups.

CS take-up is lower among underrepresented students.

We find substantial heterogeneity in students' likelihood of taking a CS course when their high school offers it. While high schools offering CS raises the chance of students taking a CS course by about 6 percentage points for all students, CS course take-up is only about 5 percentage points for females and low SES students (Figure 3). Black and White students take CS at similar rates while Hispanic students are much less likely and Asian students much more likely to take a course.



RESEARCH METHODS

Our research design exploits the fact that high schools adopted CS courses at different points in time. We compare cohorts of students exposed to CS to cohorts of students from the same high school that were not exposed to CS. To address concerns about students selectively sorting into high schools on the basis of CS course offering, we leverage quasi-random variation driven by *unexpected exposure* to CS. We compare students concurrently enrolled in high school when CS is first offered (unexpectedly exposed) to students who enrolled in high school before CS is offered (unexposed). Students who enroll in high school after CS is offered are excluded from the analysis to mitigate concerns about sorting. Focusing on unexpected exposure enables us to estimate causal impacts of both CS course offering and course-taking.

POLICY IMPLICATIONS

Maryland's "CS for All" policy is a promising approach.

The positive effects of CS course-taking—particularly for females, low SES students, and Black students—are reasons for optimism about "CS for All" policies' potential to boost the supply of CS degree recipients and improve students' labor market outcomes. Other research has found that taking advanced secondary science coursework raises STEM degree receipt for male students by 6 percentage points[3] while taking advanced secondary mathematics coursework raises engineering degree receipt by 9 percentage points and earnings by almost 30% for females.[4] Thus, policies that expand high school STEM offerings can increase degree receipt in related fields, but how these policies are implemented plays a critical role in determining who takes courses and who benefits from course take-up.

Policymakers should focus on boosting CS course participation for students who have been historically underrepresented in CS fields.

Universal access to CS coursework is unlikely to eliminate demographic gaps in CS course participation because there is substantial variation in CS course take-up across groups within schools. Prior research shows that female students in California are much less likely to take CS despite having similar access relative to male peers.[5] Similar patterns hold in national data, which show male students are more than twice as likely to take CS compared to females.[2]

Maryland and other states may consider a few policies to eliminate gaps in CS participation. First, states could follow the lead of those that have adopted CS graduation requirements—South Carolina and Arkansas have graduation requirements and are much closer to having a representative share of females take CS.[2] Research further shows that raising high school math requirements increases Black students' completed math coursework and earnings.[6] The effect of CS graduation requirements is a fruitful area for future research.

Second, states should offer rigorous foundational CS courses and provide exposure to CS in elementary and middle school. More evidence is needed about the effects of different CS course types and whether early exposure to CS can boost CS participation in high school and college.

Third, states may offer financial incentives for students and teachers to increase CS participation and performance. Prior research has shown that providing financial incentives for passing scores on AP exams increases attainment and earnings, particularly for Hispanic students.[7]

Rapid expansion of CS courses raises questions about capacity to fulfill new requirements.

The number of states requiring all high schools to offer CS coursework has increased from four in 2017 to thirty in 2023.[2] This rapid growth raises concerns about whether schools are prepared to implement new CS requirements and whether there is an adequate supply of teachers to meet growing demands for CS courses. Researchers should explore how schools are implementing new CS requirements and training CS teachers. To ensure students have access to effective CS instruction, states may also allocate funding to expand CS certification pathways. Offering professional development on CS content and pedagogy is another critical step to promote impactful CS instruction.

Acknowledgements

We are grateful for financial support from the Maryland Center for Computing Education. The contribution of Conrad is also part of the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE 1840340. We also thank staff members at the MLDS Center and the Maryland Center for Computing Education for their support on data access and the identification of computer science courses. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding organizations.

Endnotes

[1] Bureau of Labor Statistics, "Occupational Outlook Handbook," 2023.

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