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UNIVERSITY OF WISCONSIN–MADISON™

The Economics of UW-Madison White Paper #2

The Return to Majors at UW-Madison*

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Executive Summary

- There is substantial variation in salaries across majors upon graduation. While the median starting salary of a Computer Science major from UW-Madison is about $74,000, the median starting salary of a Psychology major is $30,000.
- The lifetime returns vary considerably. The lifetime return to an Economics major exceeds that of an Engineering major, even though Engineering graduates start with a higher salary. Some majors involve a lower starting salary that trades off against a higher growth rate in the future. Education majors have the lowest earnings over their lifetimes, with the second lowest being Area/Ethnic/Cultural/Gender Studies.
- The lifetime return to some UW-Madison majors is lower than the lifetime return to the top 10% of high-school graduates who did not attend college. Since UW-Madison admits fewer than 5% of graduates from Wisconsin high schools, this implies that some majors have an internal rate of return lower than the market interest rate.
- Research suggests that students have incorrect information on the returns to majors and benefit when provided with information on returns to majors. Universities have an obligation to provide prospective students and families with such information.
- Rather than forgiving student loan debt, public policy should recognize that the main problem with student debt is lack of earnings. Students' lack of information about the impact of major choice on lifetime earnings is sadly setting some of our graduates on a road to high debt and low earnings.

Among graduates with a bachelor's degree from UW-Madison, earnings vary significantly across majors. For example, figure 1 shows that, in the first year after receiving a bachelor's degree from UW-Madison in 2016-18, median earnings range from about $30,000 among Psychology majors to about $74,000 among Computer Science majors.[1] In comparison, the median earnings of all individuals with a bachelor's degree from UW-Madison in 2016-18 are $44,836 (the dashed line).

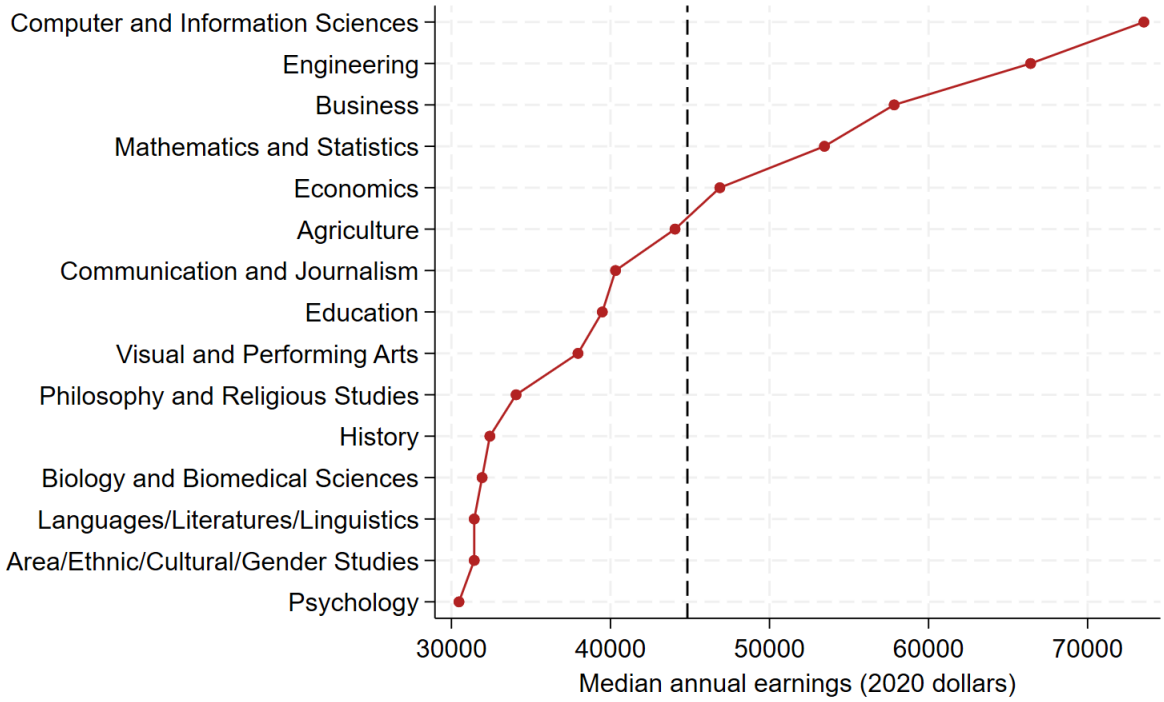

Figure 1: Median annual earnings in the first year after receiving a bachelor's degree from UW-Madison, 2016-18

Notes: The dashed line indicates the median across UW-Madison graduates of all majors. Data source: U.S. Census Bureau.

This paper estimates the (net private lifetime) returns to different majors at UW-Madison. In addition to the starting salary, we also account for differences in earnings growth across majors. We first calculate the median discounted lifetime earnings for each major, and then subtract both the direct and opportunity costs of obtaining the major. The direct cost includes tuition, fees, and costs for required course material and educational supplies at UW-Madison. To account for the fact that UW-Madison students tend to be better than the majority of high-school graduates who did not attend college, our baseline estimates measure the opportunity cost as the 75th percentile of discounted lifetime earnings of high-school graduates without any college education. We also report estimates where

[1] This figure uses data from the U.S. Census Bureau, where median earnings are measured in 2020 dollars and reported in three-year graduation cohorts, e.g., 2016-18, 2013-15, etc. The 2016-18 cohorts are the latest where earnings are available for at least one year (the first year).

the opportunity cost is measured as either the median or the 90th percentile of discounted lifetime earnings of high-school graduates without any college education.

Using a similar approach, our first paper in this series finds that there are substantial returns to a bachelor's degree from UW-Madison (Guo et al., 2024). In this paper, we find that the returns vary significantly across majors. Relative to the 75th percentile of discounted lifetime earnings of high-school graduates, when the interest rate is 5%, the return to a bachelor's degree in Education is negative $71,000 for Wisconsin residents, compared to $1.6 million for Computer and Information Sciences. Relative to the 90th percentile of discounted lifetime earnings of high-school graduates, the return is negative for more majors, while it is about $1 million for Computer and Information Sciences.

Given the large variation in earnings by major, why aren't more students choosing majors with higher earnings? In addition to individual preferences, economics research finds that the lack of information about returns associated with each major also plays a role. By providing these estimates, we hope this report could help UW-Madison students make a more informed choice.

1 Baseline Estimates

We define the (net private lifetime) return to each major m at UW-Madison as

$$R_m = \sum_{a=22}^{65} \frac{y_{m,a}}{(1+r)^{a-18}} - \sum_{a=18}^{21} \frac{D}{(1+r)^{a-18}} - \sum_{a=18}^{62} \frac{y_{h,a}}{(1+r)^{a-18}} \tag{1}$$

where $y_{m,a}$ is the median earnings at age a of UW-Madison graduates with major m, D is the direct cost that includes tuition, fees, and costs for required course material and educational supplies at UW-Madison, $y_{h,a}$ is the 75th percentile of earnings at age a of high-school graduates without any college education, and r is the interest rate.

In equation 1, we assume that high-school graduates work from age 18 to 62, the average retirement age among high-school graduates (Rutledge et al., 2018). We assume it takes four years to earn a bachelor's degree, so that UW-Madison alumni work from age 22 to 65, which is the average retirement age among college graduates. UW-Madison students pay cost D in each of the four years they are matriculating.[2]

For UW-Madison graduates, we measure the first-year earnings (at age 22) of each major as the median displayed in figure 1. Earnings growth has an age-dependent component

[2]The average number of years taken to obtain a bachelor's degree at UW-Madison is slightly less than 4 and varies across majors (UW-Madison, 2023a). This variation is ignored for simplicity.

that is common across majors and a major-specific component. For high-school graduates, we measure first-year earnings as the 75th percentile of earnings at age 18 estimated from the Current Population Survey (CPS). The age-dependent earnings growth rates are also estimated from the CPS. The details are in the appendix.

We set $r = 5\%$, and calculate the return R_m for two values of the direct cost D: \$12,246 and \$40,134. These were the costs in 2020-21 for Wisconsin residents and nonresidents, respectively. The costs for other years are similar (UW-Madison, 2023b).

Figure 2 reports the estimated returns for each major. For Wisconsin residents, the return ranges from negative \$71,000 for Education to \$1.6 million for Computer and Information Sciences. Due to the higher tuition and fees, the returns are smaller for nonresidents. In addition to Education, Area/Ethnic/Cultural/Gender Studies is another set of majors with negative returns for both Wisconsin residents and nonresidents.

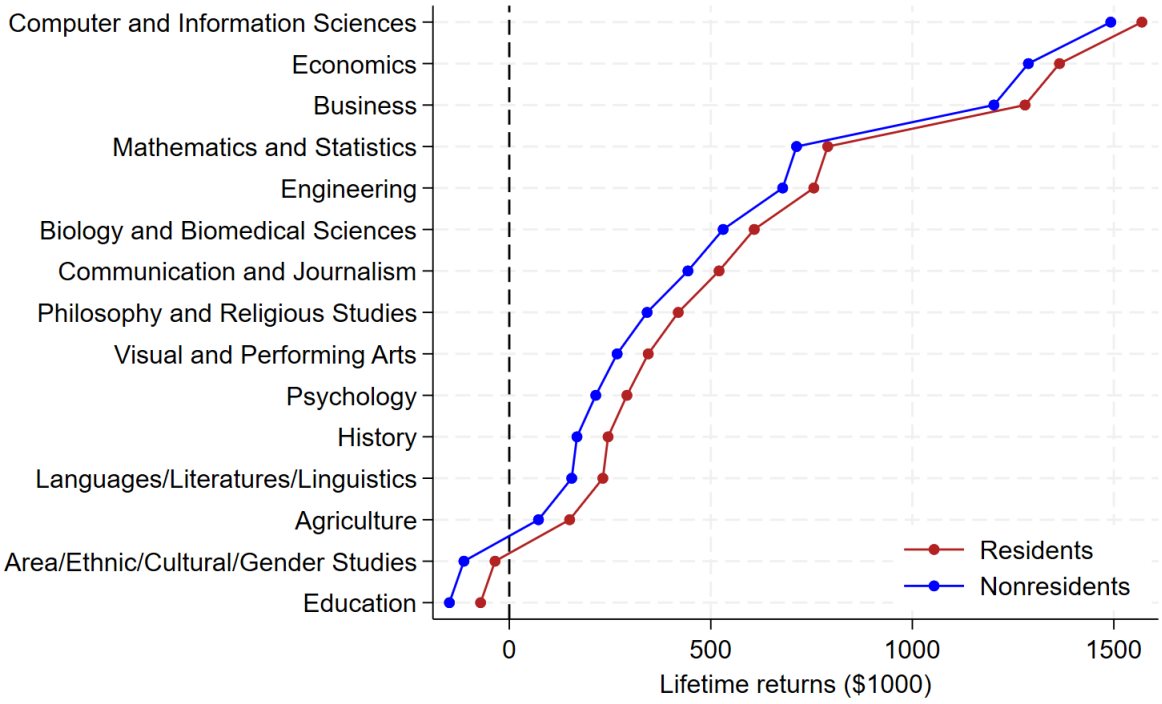

Figure 2: Lifetime returns to different majors at UW-Madison (\$1000)

Because some majors with lower starting salaries have higher earnings growth, the rankings of majors in figure 2 are different from those in figure 1. In particular, even though the median starting salary of an Economics major is lower than that of Engineering, the reverse is true for lifetime returns.

While we use a 5% interest rate, it should be noted that both the level of the return to each major and the rankings of returns across majors vary with the interest rate. In

particular, because earnings at later ages are discounted more heavily, other things equal, the interest rate r has a larger effect on returns to majors with higher earnings growth.

To see this, figure 3 plots the internal rate of return for each major, defined as the interest rate r at which the return R_m is zero. For both Wisconsin residents and nonresidents, there is no interest rate r at which the return to an Education major is zero. As a result, the internal rate of return is not defined for that major. Otherwise, the internal rate of return for Wisconsin residents ranges from 3.6% (Area/Ethnic/Cultural/Gender Studies) to 29.5% (Computer and Information Sciences).

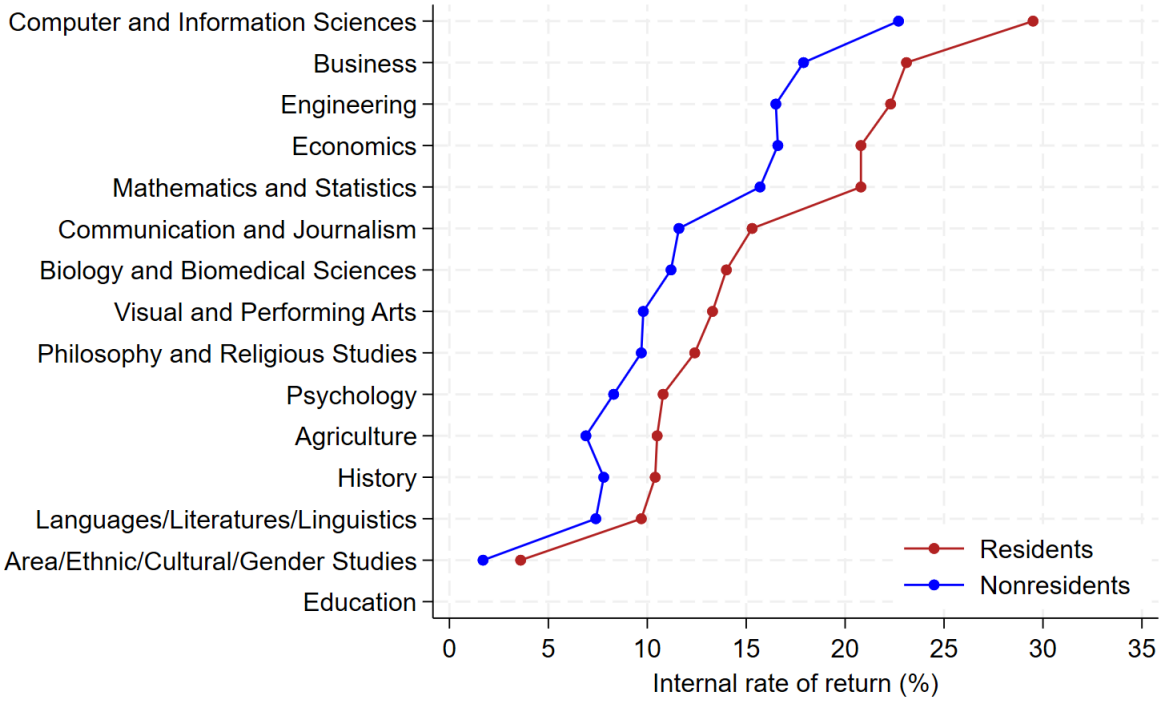

Figure 3: Internal rates of return for different majors at UW-Madison (%)

2 Discussion

We now discuss some important factors abstracted from our baseline estimates.

2.1 Data and the cohort effect

Our baseline estimates use the median first-year earnings of those who graduated from UW-Madison in 2016-18 (figure 1), the latest cohorts for which the statistic is available. The earnings, however, are highly correlated across cohorts. For example, the correlation between the 2016-18 cohorts and the 2013-15 cohorts is 0.97, and the correlation between the 2016-18 cohorts and the 2001-03 cohorts, the first three cohorts in the data,

is 0.93. This suggests that our baseline estimates are not significantly affected by potential idiosyncrasies of the latest cohorts, e.g., they graduated at a different phase of the business cycle than other cohorts.

2.2 Selection

Because UW-Madison admits less than 5% of high-school graduates from Wisconsin, the 75th percentile of discounted lifetime earnings of high-school graduates may not be a good measure of the opportunity cost of at least some majors.

Instead of the 75th percentile, figure 4 reports the estimated returns when the 90th percentile of discounted lifetime earnings of high-school graduates is used as the opportunity cost. In practice, we inflate $y_{h,a}$, the 75th percentile of earnings of high-school graduates at age a, by a factor of 1.28, which is the ratio between the 90th percentile and the 75th percentile of earnings of high-school graduates at age 18 estimated from the CPS discussed in the appendix. For both Wisconsin residents and nonresidents, the return is now negative for many majors, while it is still above $500,000 for Business and Economics and nearly $1 million for Computer and Information Sciences.

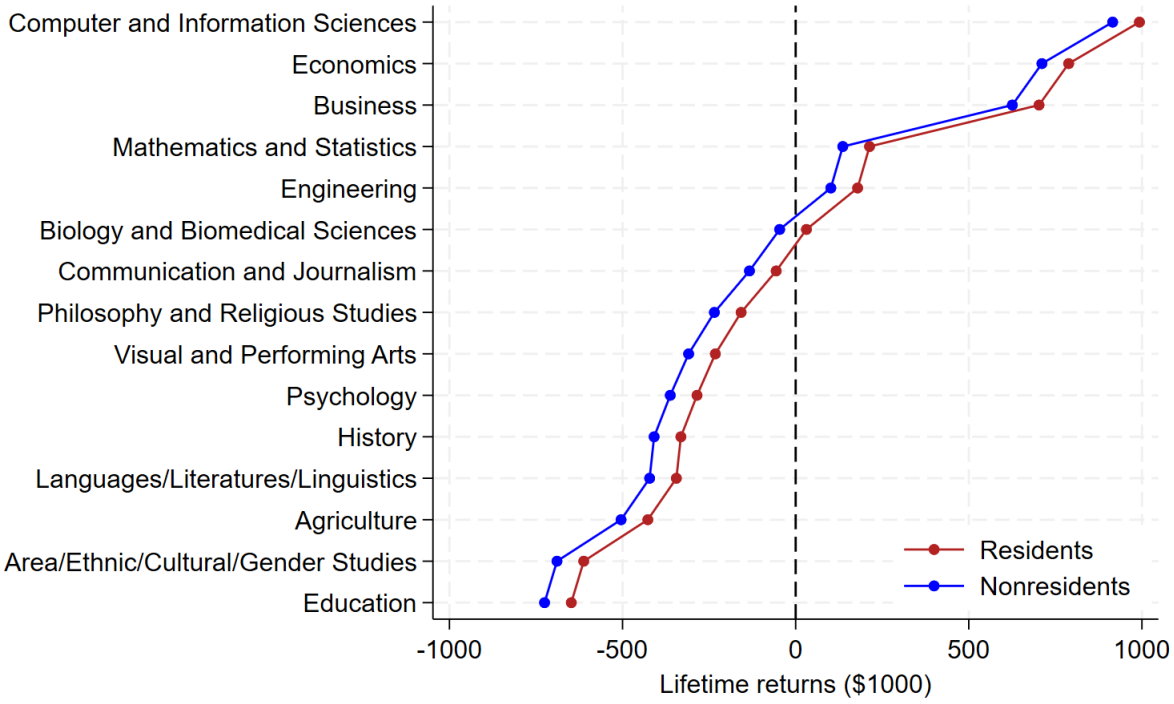

Figure 4: Lifetime returns by major ($1000): relative to the 90th percentile

Figure 5 reports the estimated returns when the opportunity cost is measured as the median discounted lifetime earnings of high-school graduates. The could be a more appropriate measure for majors that are not very selective. In practice, we multiple $y_{h,a}$, the

75th percentile of earnings of high-school graduates at age a, by a factor of 0.73, which is the ratio between the median and the 75th percentile of earnings of high-school graduates at age 18 estimated from the CPS discussed in the appendix. Now the return is positive for all majors. But it still varies significantly across majors. For Wisconsin residents, the estimated lifetime return ranges from $135,000 for Education to $1.8 million for Computer and Information Sciences.

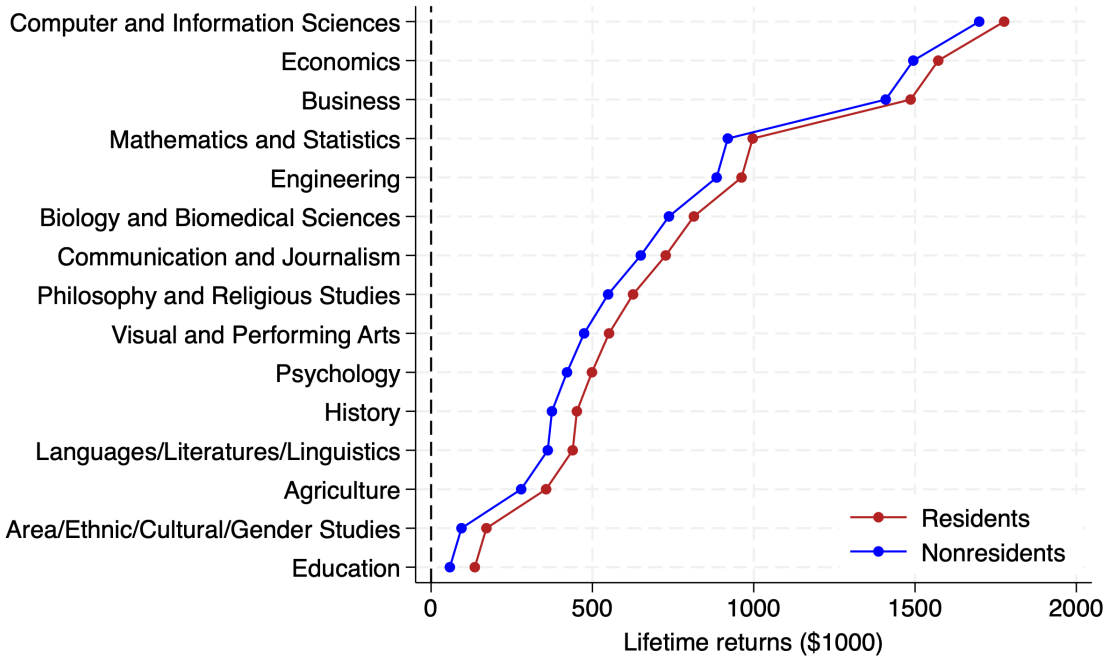

Figure 5: Lifetime returns by major ($1000): relative to the median

The opportunity cost would vary across majors if UW-Madison students are not comparable across majors. For example, if the opportunity cost for UW-Madison graduates whose majors are Education, History, and Computer and Information Sciences are the median, 75th percentile, and 90th percentile of discounted lifetime earnings of high-school graduates, respectively, the returns to the three majors would be given by the estimates in figures 5, 2, and 4, respectively. For Wisconsin residents, this implies the return to an Education major is $135,000, compared to $245,000 for History and about $1 million for Computer and Information Sciences.

By comparing students from the same high school, with the same test scores and other characteristics, and attending the same college, economics research finds that the variation in earnings by major largely reflects a causal effect of college majors on earnings rather than the selection of who chooses which major (Andrews et al., 2022).

2.3 What drives major choices?

Given the large variation in earnings by major, why aren't more students choosing majors with higher earnings, e.g., Computer and Information Sciences?

One reason is that the return to a major may vary across students depending on their ability. As noted by Arcidiacono (2004), "[m]aterial covered and the jobs associated with particular majors demand different sets of skills, some of which are learned in college. The difficulty in mastering these skills may vary with ability". For example, while large on average, the return to a Mathematics and Statistics major may be low for individuals with low math ability.

Another reason is that individuals may have different preferences for different majors. For example, an individual who likes to be a teacher may choose to major in Education even if the monetary return to the major/occupation is low. In fact, Arcidiacono (2004) finds that preferences play a much more important role than ability in the sorting of individuals across majors.

Finally, (the lack of) information about one's ability to master and the returns associated with each major also affect major choices. For example, Arcidiacono (2004) finds that students tend to learn new information about their ability through grades and use the information to decide whether to switch to a different major: "Those who perform worse than expected are more likely to drop out or switch to a less difficult major, while those who perform better than expected are more likely to stay in the same major or switch to a more difficult major". On the other hand, Wiswall and Zafar (2015) find that college students have biased beliefs about earnings associated with each major, and providing them with accurate information affects their major choices.

3 Appendix

We now discuss in detail how we calculate the earnings $y_{m,a}$ and $y_{h,a}$ used in equation 1.

For each major m, we assume $y_{m,22}$, the earnings in the first year after obtaining the major, is given by the earnings in figure 1. For $a \in [23, 65]$, we assume

$$y_{m,a} = y_{m,22} \prod_{s=23}^{a} (g_{c,s} \times g_{m,s}) \tag{2}$$

where $g_{c,s}$ is the earnings growth between age $s-1$ and age s that is common to UW-Madison graduates of all majors, and $g_{m,s}$ is the earnings growth specific to major m and age s.

We calculate the common component $g_{c,s}$ using the Current Population Survey. Let $y_{i,s-1}$ and $y_{i,s}$ be the annual earnings of individual i at ages $s-1$ and s, respectively. We use the median of $\frac{y_{i,s}}{y_{i,s-1}}$ across college graduates (with a bachelor's degree but no graduate or professional degree) who worked at least 1500 hours at both ages as an estimate of $g_{c,s}$.

We calculate the major-specific component $g_{m,s}$ using the average annual growth rates of median earnings by major among UW-Madison graduates. For example, for the Education major, we set $g_{m,s} = \frac{1+8.1\%}{1+12.0\%} = 96.5\%$ when $s \leq 26$, and set $g_{m,s} = \frac{1+2.5\%}{1+5.6\%} = 97.1\%$ when $s \geq 27$, where 8.1% is the average annual growth rate of median earnings between the first and fifth year after graduation among UW-Madison graduates whose majors are Education, 12.0% is the average annual growth rate of median earnings between the first and fifth year after graduation among UW-Madison graduates of all majors, 2.5% is the average annual growth rate of median earnings between the fifth and tenth year after graduation among UW-Madison graduates whose majors are Education, and 5.6% is the average annual growth rate of median earnings between the fifth and tenth year after graduation among UW-Madison graduates of all majors.

Similarly, for high-school graduates, we assume

$$y_{h,a} = y_{h,18} \prod_{s=19}^{a} g_{h,s}. \tag{3}$$

We estimate $y_{h,18}$ as the 75th percentile of earnings at age 18 of high-school graduates in the CPS who worked for at least at least 1500 hours. Because $y_{m,22}$ are based on the median earnings of those who graduated from UW-Madison in 2016-18, we focus on high-school graduates born in 1994-1996, who were 22 years old in 2016-2018 and thus would have received a bachelor's degree had they attended UW-Madison right after high school.

For $g_{h,s}$, the earnings growth between ages $s-1$ and s among high-school graduates, we estimate it as the median of $\frac{y_{i,s-1}}{y_{i,s}}$ across high-school graduates (with no college education) who worked at least 1500 hours at both ages.

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