The Nonequivalence of College Equivalents

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Abstract: This paper shows that labor market outcomes decline with the age at bachelor's degree (BA) attainment for white males. When a BA is attained before age 24, its premium is more than three times that of a BA premium attained at age 24 or later. This difference is not driven by selection: 90 percent of the association remains after adjusting for pre-college factors. Initial occupations one year after BA completion are similar whether an individual graduates on-time or not. At age 35, however, on-time graduates are in occupations with higher expected income and education. Our findings are consistent with a job-ladder story in which late-BA attainers do not fully capture the earnings premium of their traditional counterparts. This is either because their pre-BA work experience is a weak substitute for the skills required in BA-level jobs or because the negative signals of late attainment counteract any positive effect of pre-BA experience.

Keywords: College Earnings Premium; Lifetime Earnings; Age of Attainment; Jobs Ladder
JEL Classification Codes: I26; I24; J24; J31

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1 Introduction

Age at attainment is typically a secondary consideration when studying the wage premium associated with a college degree (Ashworth and Ransom (2019); Oreopoulos and Petronijevic (2013)). The traditional path is for college attendance to follow high school completion - without a gap in time - and for college graduation to occur within 4 to 6 years. Many college degrees are attained later in life, though, on a non-traditional path (Adelman (2006); Bound et al. (2012); Deming (2023)).[1] For example, among white males in the National Longitudinal Survey of Youth 1997 (NLSY97), over one-third of BA holders received their degree when aged 24 or older, with 7 percent earning their degree when aged 30 or older.

How much does the timing of degree completion matter for the BA premium? Do late BA attainers earn the same college premium upon completion as their younger counterparts do, or is there a penalty for finishing later? And beyond short-term differences in the returns to holding a BA, how does the timing of attainment affect a individual's lifetime earnings? Do late completer's lifetime earnings catch up to their on-time peers or do they remain behind permanently?

The answers to these questions are important for several reasons. First, from a measurement standpoint, if the college premium declines by age of attainment, then the college premium for individuals that earn a BA at a traditional age would be underestimated (Light (1995); Bárány et al. (2023)). Second, our findings directly inform the calculus around returning to college at a later age. The skills demanded in the labor market are changing (Acemoglu and Restrepo (2022); Bowlus et al. (2023)), putting pressure on older workers to learn new skills in order to remain competitive. Should older workers without four-year college degrees be encouraged to enroll in college? It is not clear that their future earnings increase sufficiently to outweigh the time and effort to get a college degree. Such individuals might benefit more by pursuing a two-year degree (Jacobson et al. (2005); Leigh and Gill (1997) or by increasing their skills through other non-degree/certificate programs (e.g. Xu et al. (2024)).

This paper shows that for white males in the National Longitudinal Survey of Youth 1997 (NLSY97) whose terminal degree is a BA, lifetime individual earnings up to age 40 are monotonically declining in age at attainment. Those who attain a BA when aged 23 or younger have a $683 thousand lifetime earnings premium over high school graduates, compared to a $203 thousand premium for those who attain a BA when aged 24-39, a ratio of 3.4. The lifetime BA premium is declining in age even within the common ages of college completion (21-23). While all BA holders have higher lifetime earnings than those whose terminal degree is a high school diploma, the earnings difference is not statistically significant for those attaining their BA in their 30's.

The lifetime earnings premium is a combination of earning higher wages for holding a degree and the number of years the degree in held during their working life. Depending on the mechanisms

[1] Later degree attainment could be due to extended time to degree (Bound et al. (2012); DesJardins et al. (2002)), periodic enrollment (DesJardins et al. (2002, 2006)) or delayed entry into college (Adelman (2006)). The phenomenom of late BA attainment has been shown to reach back to the 1930s but has recently decreased the most for women and minorities (Bárány et al. (2023)).

that generate the college wage premium (Castex and Dechter (2014); Arcidiacono et al. (2010); Cawley et al. (2001)), a college degree attained later in life might have similar effects on wages regardless of the age at attainment. Since this is not the case, we explore what might be driving the decreasing lifetime returns to BA with age of attainment.

It is possible that late attainers do not experience a college wage premium, either because employers interpret late attainment as a negative signal and/or because late attainers have characteristics that lower their market wages. We might suspect this mechanism due to the evidence on the General Educational Development (GED) credential, which finds that this alternative path does not carry the same labor market benefits as an actual high school degree (Cameron and Heckman (1993), Heckman et al. (2011)).[2] As well, in the case of college degrees, existing research has shown that individual characteristics are correlated with age of attainment. In particular, higher socioeconomic status is positively correlated with future earnings but is negatively correlated with age of college completion (Adelman (2006)) and time to degree (DesJardins et al. (2002)).[3]

In our analysis, we do not find evidence that selection is the main driver of the negative association between age at attainment and the lifetime BA premium. Ninety percent of the association remains after adjusting for observable pre-college factors including test scores, parental income, mother's educational attainment, and household structure.

Instead, we find evidence that time spent on the jobs ladder appears to be the most important contributor to the association between age at attainment and the lifetime earnings premium of a BA. Initial occupations one year after BA completion are similar whether an individual graduates on-time or not. At age 35, however, on-time graduates are in occupations with higher expected income and education. These results are consistent with a jobs ladder mechanism in which workers with college degrees spend time switching jobs to sort into occupations where wages grow faster (Deming (2023)). Those who attain a BA at older ages have less time by age 35 to sort into these occupations and less time for their wages to grow. This interpretation is backed by subsequent analysis investigating job tenure in the NLYS97. Individuals who earned their BA later in life have less tenure at their employer by age 35 than those who earned their BA earlier in life.

2 Data

Our analysis uses the National Longitudinal Survey of Youth 1997 (NLSY97), a cohort born between 1980 and 1984 first interviewed between the ages of 12 and 18. We analyze two samples:

Samples

Cross-Sectional : This sample comprises 6,748 respondents and was designed to be representative

[2]Recent evidence indicates that tailored paths to a high school degree later in life can improve labor market outcomes (Brough et al. (2024)).

[3]Bound et al. (2012) show that while individual characteristics are associated with college completion, they do not explain the increasing time to degree observed in the United States over time. They argue that the evidence suggests that decreased resources, particularly at less-selective public universities, are the cause of lengthening time to degree.

of people living in the US during the initial survey round, 1997. This sample measures degree-holders inclusive of subsequent degrees.

Non-Hispanic White Males : This sample comprises 2,286 respondents. This sample measures terminal-degrees, with a focus typically on those with a BA or a high school diploma.

We use the first sample to understand the overall picture of educational attainment in the US. For this purpose, we first report a set of descriptive statistics using the Cross-Sectional sample. These statistics will typically refer to BA holders when this need not be their terminal degree, classifying together those whose terminal degree is a BA together with those whose terminal degree is a graduate degree. We use the second sample for the remainder of our analysis. This analysis focuses on those BA holders for which the BA is their terminal degree. The reason we focus on terminal BA holders is to ensure that the labor market dynamics we find are driven by age at BA attainment and not by age at graduate degree attainment. The reason we focus on non-Hispanic white males is to focus attention on labor market dynamics due to age at BA attainment, not any of the myriad mechanisms related to race or gender. The interaction of race and gender with age at BA attainment is an interesting topic worthy of further exploration.

We construct the age of BA attainment by comparing the date of bachelor's degree attainment (CVC_BA_DEGREE) with the respondent's birth date. To understand the paths taken to get to each degree, we use the age of highest degree received to create variables indicating the terminal degree received by each respondent along with the path taken through other degrees. These terminal degree categories are high school dropout; General Equivalency Degree (GED); high school diploma (HS); Associate of Arts (AA) after GED; Associate of Arts (AA) after HS; Bachelor of Arts (BA) degree after GED; Bachelor of Arts (BA) degree after HS; Bachelor of Arts (BA) degree after AA; Master of Arts (MA); or a graduate degree greater than an MA, including Juris Doctor (JD), Medical Doctor (MD), or Doctor of Philosophy (PhD). To analyze the ages at which degrees were received, we compare the created variable that is the age at which a degree was received (for example, CVC_HS_DIPLOMA) and the respondent's date of birth.

In regression analyses we will often use the direct measure of age at BA attainment measured in years as a real number. Among those whose terminal degree is a BA, we often use a coarse partition to compare On-Time BA attainment with Late BA attainment. This coarse partition is helpful for seeing broad patterns in the data. When it is useful to look at more detailed patterns in the data, we also consider a fine partition of age at BA attainment that is a refinement of the coarse partition:

Partitions of Age at BA Attainment

On-Time: Those who attained their BA degree before reaching age 24
Coarse Bin: Age $\in [21, 24)$
Fine Bins: Age $\in [21, 22)$, Age $\in [22, 23)$, or Age $\in [23, 24)$

Late: Those who attained their BA degree at age 24 or later.
Coarse Bin: Age $\in [24, 39)$

Fine Bins: Age $\in [24, 29)$ or Age $\in [30, 39)$

To characterize labor market outcomes we consider individual labor market earnings, which we always measure in 2018 dollars by deflating with the Consumer Price Index For All Urban Consumers (CPI-U). Due to the biennial nature of the latter waves of the NLSY97, our primary variable is a measure of average annual earnings over 5-year age windows, 20-24; 25-29; 30-34; and 35-39, where the average includes years with \$0 as reported earnings. We define lifetime earnings as the sum of each 5-year average multiplied by 5 and summed across ages 20-39. We measure wages at an annual frequency as individual labor market earnings divided by annual hours worked.

We use pre-college observable characteristics in the analysis. These characteristics include parental income in the 1997 wave of the survey; household structure (2 biological parents, 2 parents with one biological, 1 parent, grandparent(s), and other); mother's educational attainment; and test score percentile on the Armed Services Vocational Aptitude Battery (ASVAB) taken when aged 12 to 16.

We later investigate occupational sorting by combining occupations worked by individuals in the NLSY97 at different points in time with occupational characteristics collected from multiple years of the Census and American Community Survey (ACS). There are a large number of occupations reported by individuals in the sample so to investigate occupational sorting we construct characteristics indices for occupations and then analyze differences characteristics of occupations. Specifically, the NLSY97 reports occupations based on Census and American Community Survey codes so we can use those data sources to construct measures of the characteristics of the occupations reported.[4] Because our NLSY97 sample is white males, we also use that as the basis for our occupational measures and collected data on white males between the ages of 16-64 from IPUMS USA (Ruggles et al. (2024)). From those samples, we construct measures of median income in the occupation and percent of individuals with a BA in the occupation. The American Community Survey has data annually beginning in 2005 but some of the sample complete their degree prior to that (in practice we need data starting in at least 1997). So we also collected data from the Census for 1970, 1980, 1990 and 2000 and used a kernel function to interpolate the missing years.[5]

3 Education Patterns in the Cross-Sectional Sample

We first use the cross-sectional sample to show levels of attainment and paths to attainment for individuals in this birth cohort. Figure 1 shows the shares of terminal degrees, broken down by the paths through previous degrees, for respondents aged 34-40 in the 2019 wave of the NLSY97.

[4]The coding changes over time so we first convert occupations into the time invariant coding used by Autor and Dorn (2013) and Autor (2015). This provides 334 different categories of occupations over time.

[5]Specifically, we first construct our occupation measures for each available year. We next linearly interpolate the missing data and then apply a kernel to smooth the data, reducing the discontinuities around the limited data points in the Census and reducing noisy variation in the annual data for small occupation categories. We use a triangle kernel with a 3-year bandwidth, which means that for each year of data, we use information from the current year and the 3 years pre- and post- to construct an average with more weight placed on the closer years. Results do not appear sensitive to choice of bandwidth.

10 percent of respondents are high school dropouts who had attained no degree and 11 percent had attained a General Educational Development (GED) credential. The largest attainment group holds a high school diploma; this is 40 percent of the population.

Our analysis focuses on the transition from a high school diploma to a BA because, first and foremost, as shown in Figure 1, transitioning to a BA from high school is far more common than transitioning from a GED or an AA (Reynolds (2012)). Second, for BA attainment there is a clear "on time" group who complete their degree before reaching age 24 and a long "late" tail who finish later. Figure 2a shows the wide range of ages at which people attain their BA degree. Most BA holders (59.6 percent) get their degree before turning 24. However, there is a substantial fraction of BA holders who attain their degree at older ages. For instance, the 90th percentile is 31.2 years.

Most people attain their high school diploma or BA in a narrow age range; this is characterized by the steep CDFs in Figure 2a. Nearly all respondents who received their high school diploma did so at age 18; 87 percent of high school graduates attain their diploma before turning 19. The degrees with the most uniform age distributions are the GED, AA, and graduate degrees. There is a 10 year gap in the age at attainment between the 10th and 90th percentile GED holders. That gap is 10 and 13 years, respectively, for graduate degree and AA attainment.

The premium of earning a degree when younger is observed across nearly all degrees. Figure 2b shows the premium over the previous degree for attaining a GED, a high school diploma, a BA, and a graduate degree. We estimate a linear regression of average individual earnings when aged 30-34 on indicators for terminal degree and interactions with age. We then predict the premia associated with being at the 25th percentile of age at attainment for each degree, ie "Young," and compare those with the premia associated with being at the 75th percentile of age at attainment, ie "Old." At each level of degree attainment, there is a substantive earnings premium for finishing younger.

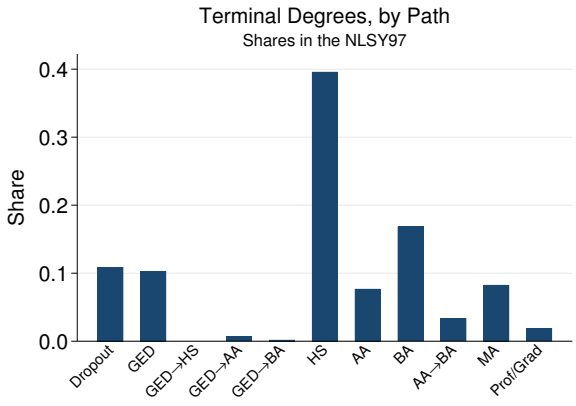
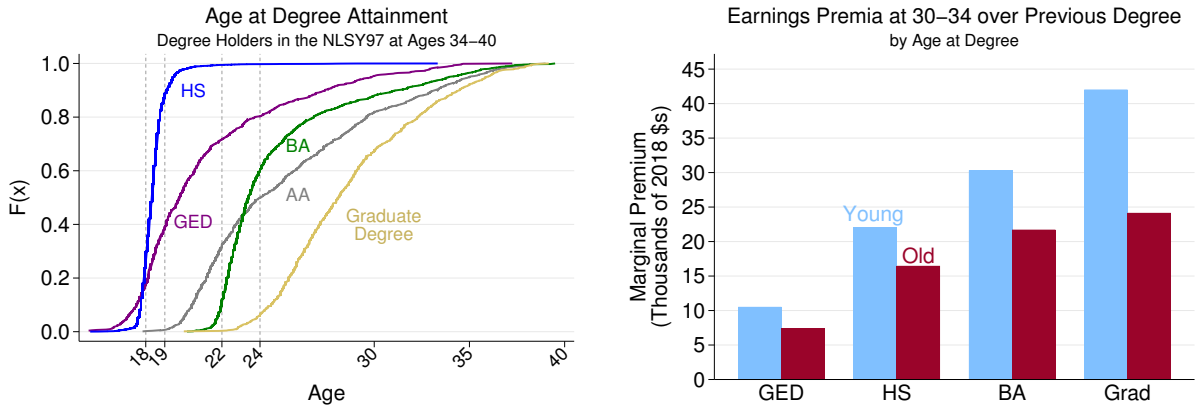


Figure 1: Distribution of Terminal Degrees at ages 34-39
Note: This figure reports statistics for the Cross-Sectional Sample designed to be nationally-representative. The figure shows the share of the population in the NLSY97 in each terminal degree when respondents are aged 34-39 (ie, the 2019 wave of the NLSY97).



(a) Age at Degree Attainment

(b) Age Penalty to Earnings Premium by Degree

Figure 2: Degree Attainment and Earnings Premia over the Life Cycle

Note: These figures report statistics for the Cross-Sectional Sample designed to be nationally-representative. The left panel shows cumulative distribution functions (CDFs) of the age at degree attainment for the Cross-Sectional Sample. The right panel shows the estimated marginal premium from attaining a given degree relative to the previous degree by age at attainment. The penalty for late-completion rises in magnitude with more advanced degrees. See the text for details of estimation.

4 Labor Market Earnings by Age at BA Attainment

4.1 The BA Premium

We now switch to the longitudinal sample of white males in the NLSY97 whose terminal degree is a BA. As discussed earlier, this sample allows us to focus on the age-of-BA effects without complications around gender and race. On occasion, we will also include white males whose terminal degree is a high school diploma to provide a benchmark for comparison. The modal path to a BA degree involves no breaks in enrollment, resulting in graduating high school at age 18 (see Figure 2a) and then obtaining a BA degree four years later, at age 22 (see Figure 3). Most BA holders attain their degree before turning 24, whether we look at the overall population (Figure 2a) or the population of white males whose terminal degree is a BA (Figure 3).

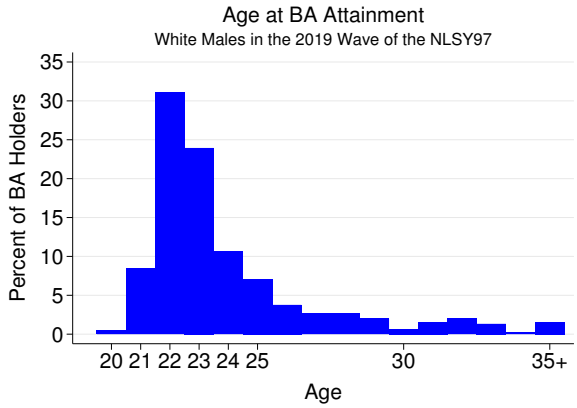


Figure 3: Age at BA Attainment
Note: This figure shows the probability mass function (PMF) of the age at BA attainment for the sample of white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was a BA.

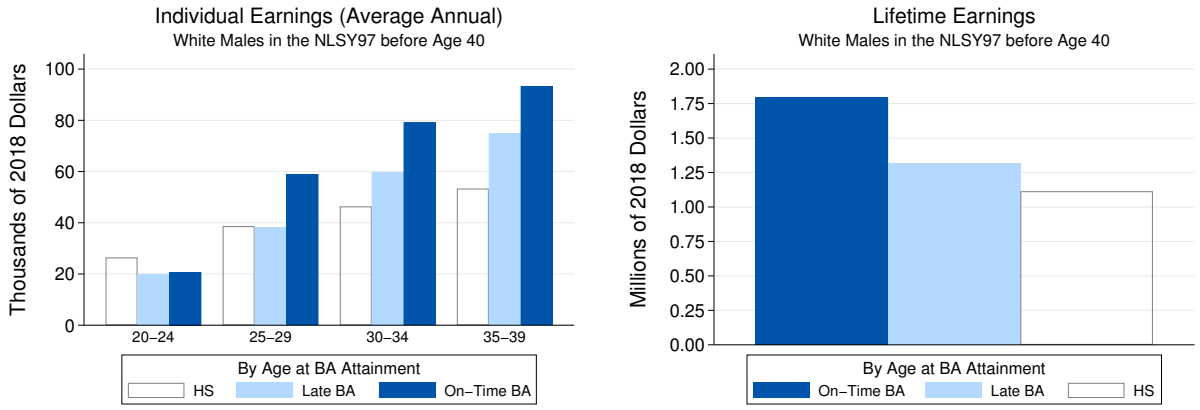
Table 1: Sample Size by Age Bin, White Male BA-Holders in the NLSY97

	Age	*N*	Cumul. Percentage
On-Time	21	40	9
	22	140	40
	23	108	64
Late	24-29	130	93
	30-39	33	100

Note: This table reports the age at BA attainment for the fine and coarse age partitions used in our analysis. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was a BA.

The age at which white males attain their BA degree predicts sharp differences in earnings over the life cycle and in lifetime earnings. Figure 4a shows the age earnings profiles of BA holders by age of BA attainment along with those whose highest degree is a high school diploma. At young ages, the average annual individual earnings of respondents with a high school diploma is actually higher than it is for both the the Late BA and On-Time BA groups. By the late 20s, the Late BA group has caught up to the high school graduates, and the On-Time BA group has surpassed them. By the early 30s, there is a clear ordering where the On-Time BA group has the highest earnings, followed by the Late BA group, followed by the high school diploma group. This ordering is maintained into the late 30s.

Differences in lifetime earnings accumulate over the life cycle. Figure 4b shows average lifetime earnings between ages 20 and 39. The average earnings for the On-Time BA, Late BA, and high school groups are \$1.80 million, \$1.32 million dollars, and \$1.11 million, respectively.



(a) Earnings over the Life Cycle

(b) Lifetime Earnings

Figure 4: Earnings by Age at BA Attainment

Note: These figures show individual earnings by the coarse partition of age at BA attainment. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was either a BA or a high school diploma.

The gradient in lifetime earnings is especially steep within the On-Time BA group. Figure 5 and Table 2 report results related to lifetime earnings by the disaggregated age groups. Recall that the mean lifetime earnings between ages 20 and 39 for white males with a high school diploma was \$1.1 million. Figure 5 shows that mean lifetime earnings for white males who graduated with a BA at age 21 was \$2.51 million. For those graduating with a BA at ages 22 and 23, mean lifetime earnings dropped to \$1.85 and \$1.51 million, respectively. Within the Late BA group, those attaining their BA in their late 20s earned \$1.34 million on average, and those who attained their BA in their 30s earned \$1.24 million on average.

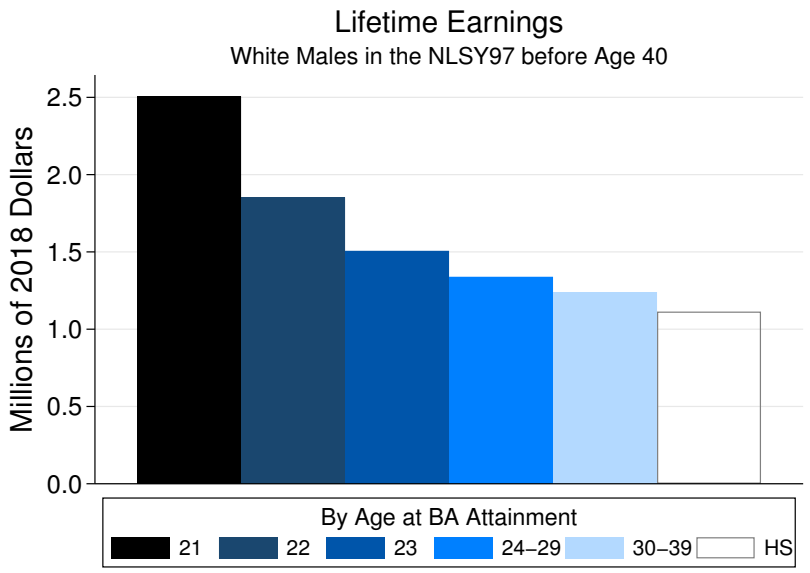


Figure 5: Lifetime Earnings by Age at BA Attainment
Note: This figure show individual lifetime earnings by the fine partition of age at BA attainment. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was either a BA or a high school diploma.

Table 2 reports the results of a regression of lifetime earnings on dummies for the fine partition of age of BA attainment where the reference group is those holding a high school diploma.[6] The premium for attaining a BA while aged 30-39 is \$0.13 million and is not statistically significant. The premium for attaining a BA at younger ages nearly doubles when crossing the threshold for each of the age groups, to a maximum of \$1.39 million for those who attained a BA at age 21. The fourth column shows that the premium of attaining a BA relative to a high school diploma is statistically different from 0 at all ages before the 30s. The fifth column shows the results of one-tailed t-tests that the premium for attaining a BA at a given age is greater than the premium for attaining a BA while in the next oldest age group. This shows that the premium for attaining a BA at age 21 is statistically larger than attaining a BA at age 22, as is the premium at age 22 relative to the premium at age 23. The premium when attaining a BA at age 23 is statistically greater than when attaining at ages 24-29 at the 8 percent level, but the premium for attaining a BA when aged 24-29 is not statistically greater than for attaining when aged 30-39.

[6] In particular, the first 5 rows correspond to the βs from the regression $Y = \alpha + \beta BA_{age} + \epsilon$ where Y is lifetime earnings and BA_{age} is the set of dummy variables corresponding to BA attainment at 21, 22, 23, 24-29 and 30-39. The left-out category is high school diploma. The bottom row represents the single β when the set of indicators BA_{age} is replaced with a single indicator for having completed a BA at any age.

Table 2: Lifetime Earnings by Age at BA Attainment,
White Male BA-Holders in the NLSY97

Age at BA Attainment	BA Premium for Lifetime Earnings (Millions)	Standard Error	P-Value of H_0 $\beta_a = 0$	P-Value of H_0 $\beta_a > \beta_{a+1}$
21	1.39	(0.16)	[0.00]	[0.00]
22	0.74	(0.09)	[0.00]	[0.00]
23	0.39	(0.10)	[0.00]	[0.08]
24-29	0.23	(0.09)	[0.01]	[0.28]
30-39	0.13	(0.15)	[0.42]	–
Any age	0.49	(0.06)	[0.00]	–

Note: This table shows estimates from a regression of lifetime earnings on dummies for age at BA attainment. The "any age" row shows the regression coefficient on a dummy for a BA completed at any age between 21 and 39. The sample is non-Hispanic white males in the NLSY97 whose terminal degree is either a BA or a high school diploma.

Appendix Figure 1 shows that this pattern is present for both means and medians of the distribution of earnings. Appendix Figure 2 shows that these differences in earnings reflect differences in average wages when aged 30-34 and not differences in hours worked.

5 Selection on Observables

Table 3 shows the results of a regression of age of BA attainment on pre-college characteristics. The second column reports raw coefficients and their standard errors in parentheses, and the third column shows the implied difference in age at attainment between the 25 percentile of the variable's sample distribution and the 75th percentile of the variable. The strongest conditional correlation with age at BA attainment is test score. The coefficients on parental income and household structure imply differences that are about one or two thirds as large as those implied by the change in test scores. The coefficient on mother's BA attainment is considerably smaller than the other variables.

Table 3: Regression of Age at BA Attainment on Observables,
White Male BA-Holders in the NLSY97

Variable	Coefficient	p25 v. p75
ASVAB Test Score Percentile	–0.04	–1.80
	(0.01)	
Parental Income	–0.02	–0.69
	(0.01)	
Parental Income^2	4.6e-5	
	(5.1e5)	
2-Biological-Parent Household	–1.29	
	(0.52)	
Mother's Ed≥BA	–0.20	
	(0.43)	
β_0	29.41	
	(1.06)	
N	216	

Note: This table reports results of a regression of age at BA attainment on pre-college factors. The sample is non-Hispanic white males in the NLSY97 whose terminal degree is a BA for which observables and lifetime earnings are present.

Another way of seeing that the chosen observables are predictive of attaining a BA on time for our sample is shown in Figure 6. What we can see is that there is somewhat muted overlap in the left tail of the estimated propensity scores. There are few on-time BA-holders with the observables predicting attaining a BA while late.

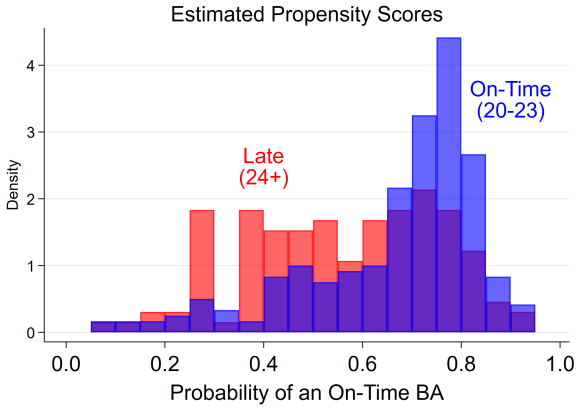


Figure 6: Predicted Probability of On-Time BA Completion by Observed On-Time/Late Status
Note: This figure shows estimated propensity scores based on observable characteristics. Specifically, the observables are test scores, parental income, household structure, and mother's educational attainment. The sample is non-Hispanic white males in the NLSY97 whose terminal degree is a BA for which observables and lifetime earnings are present.

To investigate whether selection into age at BA attainment by observable pre-college characteristics is responsible for the correlation between age at BA attainment and labor market outcomes, Table 4 shows the results of regressions of lifetime earnings on age at BA attainment. The specifications include a short regression of lifetime earnings on a quadratic of age at BA attainment alone, as well as a long regression that includes the quadratic on age at BA attainment together with the observables just previously studied in Table 3.

The key finding is that age at BA attainment has a large coefficient regardless of whether one adjusts for observables or not. In the short regression, the implied difference in lifetime earnings at the 25th percentile of the sample distribution of age at BA attainment versus the 75th percentile is \$0.48 million. In the long regression, this difference is \$0.46 million, or 97 percent of the difference implied in the short regression.

Table 4: Regression of Lifetime Earnings on Age at BA Attainment and Observables, White Male BA-Holders in the NLSY97

	Short Regression		Long Regression	
Variable	Coefficient	p25 v. p75	Coefficient	p25 v. p75
Age at BA Attainment	–0.78	–0.48	–0.76	–0.46
	(0.24)		(0.24)	
Age at BA Attainment^2	0.01		0.01	
	(0.00)		(0.00)	
ASVAB Test Score Percentile			0.00	
			(0.00)	
Parental Income			–1.4e-3	
			(3.9e3)	
Parental Income^2			5.4e-06	
			(1.5e5)	
2-Biological-Parent Household			0.13	
			(0.15)	
Mother's Ed≥BA			0.13	
			(0.12)	
β_0	13.01		12.26	
	(3.20)		(3.36)	
N	216		216	

Note: This table reports results from a regression of lifetime earnings on age at BA attainment and observable pre-college characteristics. The sample is non-Hispanic white males in the NLSY97 who hold a BA for which observables and lifetime earnings are present. See text for variable descriptions.

6 Occupational Sorting

One possible reason for differences in the returns to a BA across age could be due to differences in the types of occupations that individuals sort into immediately after their degree and the job ladder that is available to them. To investigate this, we collected information about the occupations that the NLYS97 individuals worked following their BA. We collected the occupations at two points in time: 1) the year after they earned their degree and 2) at the age of 35 or 36.[7] The former is a "relative" time measure (differing by age of attainment) and helps measure any initial sorting into occupations. The latter is an "absolute" time measure which captures where individuals are by the age of 35 or 36.

As described in Section 2, instead of using categorical measures of occupations, we form indices of occupational characteristics calculated from Census and ACS data. The basic idea is that two individuals may work in different occupations (according to coding) but if those occupations have similar characteristics, such as income, then we treat those occupations as being similar on that dimension. Our focus will be on occupation median income and percent of occupation with a BA.

We then attempt to investigate occupations characteristics similar to the presentation of lifetime earnings in Figure 5 and Table 2. Like that analysis, we also include a category for individuals with only a high school degree. For these individuals, occupations are measured one year after their high school diploma or at age 35 or 36. We also restrict the sample to those individuals who obtain their degree by age 34. We do that primarily because it limits the effects of COVID-19 on occupational measures as the youngest members of the sample turn 35 in 2019.

We begin by first measuring occupations based on their median annual income. Our primary finding is presented visually in Figure 7. While the median income of the occupation observed one year after degree is lower for those with only a high school degree, there is not much evidence of differences across age of BA attainment. On average, individuals are in occupations with approximately the same median income one year after graduation regardless of the age that the BA was obtained. Table 5 replicates the regressions of Table 2 but now using the occupational median income as the outcome, measured either one year after degree attainment (top panel) or at the age of 35/36 (bottom panel). These estimates represent a statistical test of the levels - relative to HS - and the differences across age of attainment shown in Figure 7. Estimates show that income is 17 to 22 thousand dollars higher one year after the BA compared to one year after a high school degree, and these gaps are statistically significant. However, the premiums are not statistically significant from each other as age of attainment increases; this is illustrated in the fifth column via insignificant values of one-tailed t-tests that the premium at a given age is greater than in the next oldest age group. Furthermore, replacing the categories of age at BA attainment (and restricting to the sample of BA completers) with a continuous variable for age at attainment shows no effect of age of attainment on occupational median income one year after degree. The coefficient on age at

[7] We use age 35 or 36 because NLSY97 data is only collected in odd years at this point in the survey. So individuals born in even years will have data measured at age 35, which individuals born in odd year will have data measured at 36.

attainment is 0.05, interpreted as a $50 increase for attaining the BA a year older, which is neither economically nor statistically significant (p-value = 0.898).

In contrast, there is a noticeable difference in the types of occupations - as indexed by median income - worked at age 35/36. Median occupational income is monotonically decreasing with age of BA attainment in Figure 7. The corresponding regression estimates are presented in the lower panel of Table 5. The estimated coefficients suggest that those who completed the BA at age 21 or 22 are in occupations that pay approximately 22 thousand dollars more than the occupations of high school graduates. That effect then shrinks as age of attainment increases, finishing with only a 4 thousand dollar BA premium for those who complete the BA after the age of 29. The fourth column shows that this final difference of 4 thousand dollars in the 30s is not statistically different than the median occupational income of high school grades of the same age. This is a break from the pattern when attaining a BA at younger ages; the fourth column shows that the difference in median income for a BA holder's occupation relative to that of a high school diploma holder's is statistically different from 0 at all ages of BA attainment before the 30s. The fifth column shows the values of one-tailed t-tests that the difference in median income for attaining a BA at a given age is greater than the difference in the next oldest age group. While this difference is not always statistically significant, we see a stronger signal than at one year after BA completion. Finally, the coefficient in a regression using the continuous measure of age at BA attainment is large and statistically significant. The coefficient is -1.70 (p-value = 0.00) which indicates that each year older the BA is completed is associated with a $1,700 decrease in median occupation income at 35.

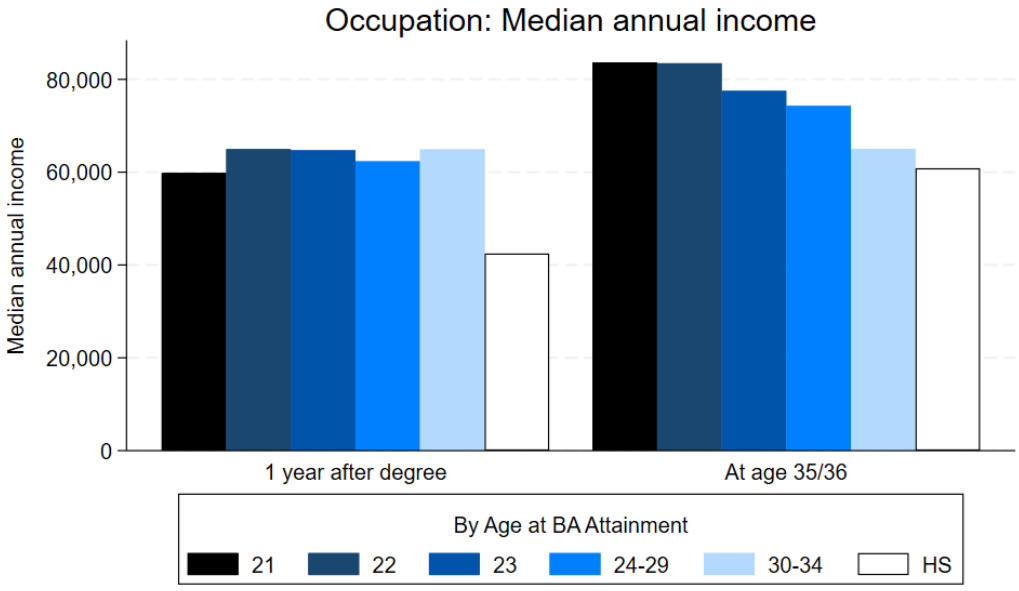


Figure 7: Median Income of BA Holders' Occupations, by Time after BA Completion and by Age
Note: The figure shows the median real annual income of the individual's occupation, as measured in Census/ACS data. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was either a BA or a high school diploma

Table 5: Median Income of Occupation by Age at BA Attainment, White Male BA-Holders in the NLSY97

Age at BA Attainment	Median income (Thousand)	Standard Error	P-Value of H_0 $\beta_a = 0$	P-Value of H_0 $\beta_a > \beta_{a+1}$
One year after degree				
21	17.36	(3.52)	[0.00]	[0.20]
22	22.49	(2.06)	[0.00]	[0.94]
23	22.24	(2.47)	[0.00]	[0.44]
24-29	19.85	(2.04)	[0.00]	[0.63]
30-34	22.42	(4.96)	[0.00]	–
Any	21.07	(1.28)	[0.00]	–
At age 35/36				
21	22.27	(4.23)	[0.00]	[0.97]
22	22.61	(2.52)	[0.00]	[0.10]
23	16.66	(2.88)	[0.00]	[0.35]
24-29	13.41	(2.23)	[0.00]	[0.04]
30-34	4.13	(4.01)	[0.30]	–
Any age	16.43	(1.46)	[0.00]	–

Note: This figure shows results from four regressions. The top panel uses data on occupations one year after degree completion. The bottom panel uses data on occupations at age 35 or 36. The first regression in each panel shows the coefficients on dummies for age at BA attainment for a regression where the dependent variable is median income of the occupation and the reference group is high school graduates. The "any age" row reports the regression coefficient on a dummy for a BA completed at any age between 21 and 39. The sample for both regressions is non-Hispanic white males in the NLSY97 whose terminal degree is either a BA or a high school diploma.

Similar results can be seen in Figure 8 which indexes occupations not by median income but by the percentage of workers in that occupation with a BA. A year after degree attainment, BA holders are in occupations with more workers with a BA compared to high school graduates - approximately 18 to 19 percentage points higher according to the estimates in the top panel of Table 6. The differences as age of BA attainment increases are small and not statistically significant. Furthermore, the regression with continuous age at BA has a small coefficient of 0.002, interpreted as 0.2 percentage points, which is not statistically significant (p-value = 0.33). So regardless of age of BA attainment, BA holders initially enter occupations that more likely match their new degree.

By age 35/36 the pattern is closer to that of income: compared to on-time BA completers, late completers are in occupations that have lower percentages of workers with bachelor degrees. Note, however, that the differences as age of attainment increases are not usually statistically significant

in the bottom panel of 6. Similarly, the regression with continuous age at BA attainment has a coefficient of -0.004 (p-value = 0.00) which suggests that each year older the BA is completed is associated with occupations at age 35/36 that have almost half a percentage point less workers with a BA. As before, this negative gradient compared to 1-year after degree is driven by larger increases by age 35/36 for the on-time completers. Those who complete their BA after 29 have the smallest increase in occupational BA percentage, but the gap to high school graduates has closed substantially for them. By age 35/36, these late attainers are in occupations that have only 10 percentage points higher percent of workers with a BA.[8]

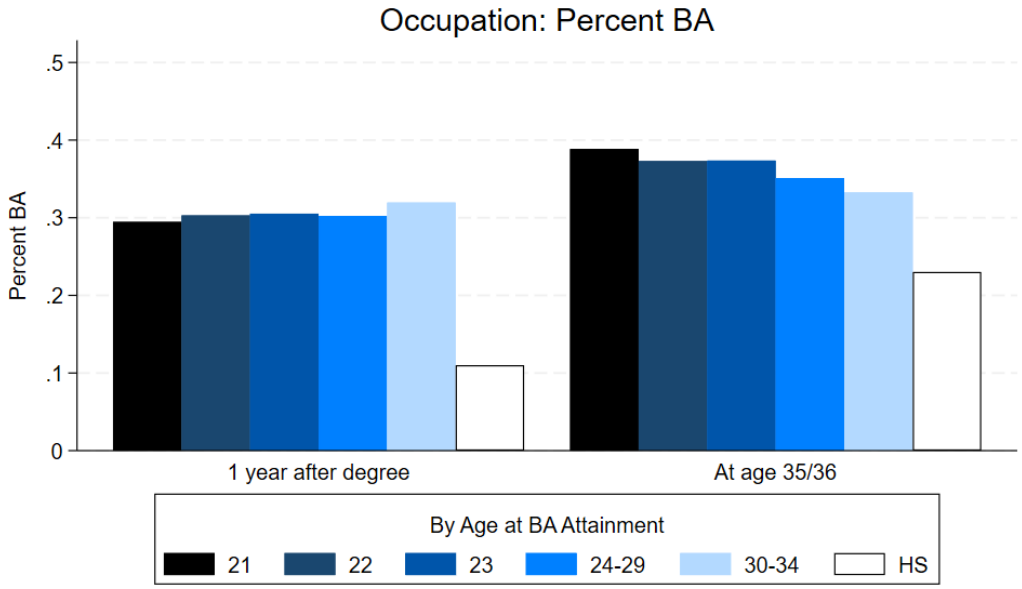


Figure 8: Percent of BA Holder's Occupation Holding a BA, 1 Year after BA Completion and at Age 35/36

Note: The figure shows the percentage of workers with a BA in the individual's occupation, as measured in Census/ACS data. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was either a BA or a high school diploma

[8]One might be worried about correlations between these outcomes and the age distribution of occupations. To test this, we replicated our results using age-adjusted occupational characteristics. To do so, we estimated regressions using the Census/ACS data for each occupational characteristic on a cubic in age fully interacted with occupation indicators. This allows each occupation to have a different intercept and age profile. We also include time fixed effects to remove variation across years. We then predict occupation characteristics early in the career (at age 24) and middle career (age 35). Using those predicted values removes any effect of differences in ages of occupations but we find that doing so has no substantive effect on the estimates. See, for example, Appendix Figure 4.

Table 6: Percent of Occupation with a BA by Age at BA Attainment,
White Male BA-Holders in the NLSY97

Age at BA Attainment	BA Percent	Standard Error	P-Value of H_0	
			$\beta_a = 0$	$\beta_a > \beta_{a+1}$
One year after degree				
21	0.18	(0.11)	[0.00]	[0.48]
22	0.19	(0.01)	[0.00]	[0.81]
23	0.20	(0.01)	[0.00]	[0.75]
24-29	0.19	(0.01)	[0.00]	[0.28]
30-34	0.21	(0.01)	[0.00]	–
Any	0.19	(0.00)	[0.00]	–
At age 35/36				
21	0.16	(0.02)	[0.00]	[0.39]
22	0.14	(0.01)	[0.00]	[0.97]
23	0.14	(0.01)	[0.00]	[0.09]
24-29	0.12	(0.01)	[0.00]	[0.27]
30-34	0.10	(0.02)	[0.00]	–
Any age	0.13	(0.01)	[0.00]	–

Note: This figure shows results from four regressions. The top panel uses data on occupations one year after degree completion. The bottom panel uses data on occupations at age 35 or 36. The first regression in each panel shows the coefficients on dummies for age at BA attainment for a regression where the dependent variable is percent BA of the occupation and the reference group is high school graduates. The "any age" row shows the regression coefficient on a dummy for a BA completed at any age between 21 and 39. The sample for both regressions is non-Hispanic white males in the NLSY97 whose terminal degree is either a BA or a high school diploma.

These results about occupational characteristics suggest a role for job ladder effects. One final piece of evidence supports this interpretation. As noted by Deming (2023), BA holders switch jobs frequently in the first 5 years after degree attainment. Furthermore, this job switching explains about half of the wage increases during this period in life while most subsequent wage increases happen within a job. Instead of looking at the characteristics of occupations, we directly look at job tenure measured in the NLSY97.

As we might expect, Figure 9 shows that median job tenure measured one year after completing the BA is about one year or less for most of the completers, consistent with individuals getting new jobs with their new degrees. There is some suggestion of "age at degree" gradient and these levels of tenure are generally statistically significant compared to the high school degree holders.

Furthermore, the longer tenure at higher ages of attainment is statistically different than the tenure of on-time completers (Table 7).

Of particular note, the individuals completing their degree at ages 30-34 have a median tenure *greater* than one year. This suggests that they may have earned their degree as part of an internal-advancement program within the firm. We find some evidence to support the hypothesis that these workers are staying with the firm by using two variables in the NLSY97 measured the year before graduation. Using annual data from the NLSY97 on whether tuition benefits are offered to employees there is a clear age gradient. About 5-7 percent of individuals who graduated on time had access to a tuition reimbursement benefit the year before graduation. This rises to 23 percent for those who completed the BA at 24-29 and further increases to 47 percent for those who completed at 30-34. Furthermore, there is evidence that these benefits were utilized more among the late attainers. Around 2-4 percent individuals who graduated under the age of 30 reported some employer assistance with tuition, compared to 13 percent of those who graduated between 30-34. These workers may benefit from a promotion within their firm but may not be moving up the job ladder as much after completing their degree as workers who find new employment.

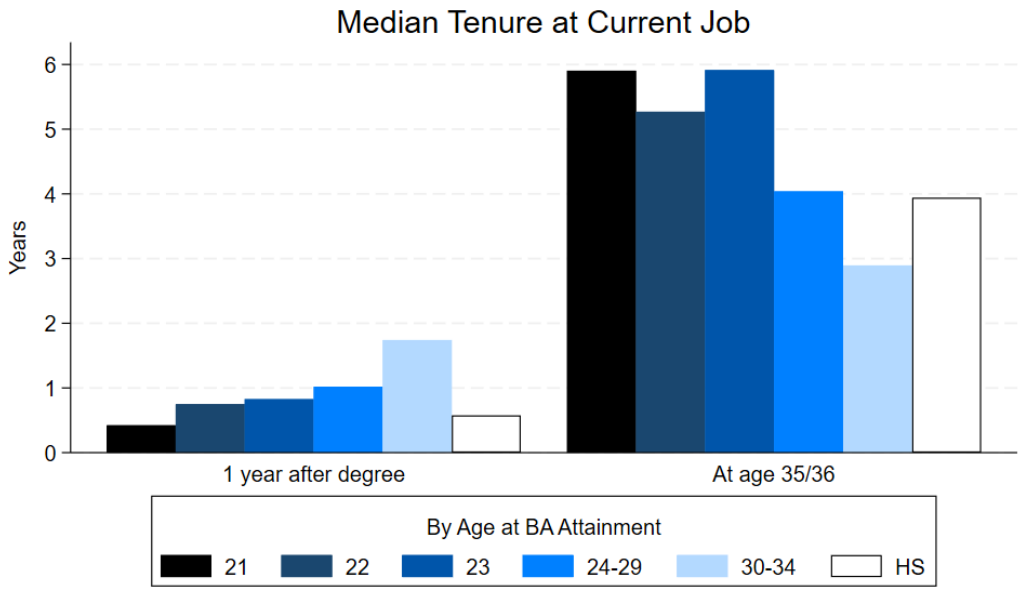


Figure 9: Median Tenure at Current Job for BA Holders, 1 Year after BA Completion and at Age 35/36

Note: The figure shows the median job tenure of individuals at their job measured at different points in time. The sample is white males in the NLSY97 whose terminal degree in the 2019 wave of the NLSY97 was either a BA or a high school diploma

A very different pattern is observed when measuring job tenure at age 35. The on-time BA completers have median tenures of 5 to 6 years, consistent with them finding long term employment. The late BA completers have median job tenure of 3 to 4 years, which is statistically significantly lower (Figure 7). Furthermore, the late BA holders have similar - or lower - median job tenure to high school degree holders.

Table 7: Median Tenure at Current Job by Age at BA Attainment,
White Male BA-Holders in the NLSY97

Age at BA Attainment	Median Tenure	Standard Error	P-Value of H_0	
			$\beta_a = 0$	$\beta_a > \beta_{a+1}$
One year after degree				
21	-0.15	(0.10)	[0.12]	[0.00]
22	0.17	(0.06)	[0.00]	[0.36]
23	0.25	(0.07)	[0.00]	[0.02]
24-29	0.44	(0.06)	[0.00]	[0.00]
30-34	1.17	(0.15)	[0.00]	–
Any	0.23	(0.04)	[0.00]	–
At age 35/36				
21	2.06	(0.67)	[0.00]	[0.33]
22	1.33	(0.39)	[0.00]	[0.23]
23	2.00	(0.44)	[0.00]	[0.00]
24-29	0.10	(0.35)	[0.78]	[0.12]
30-34	-1.04	(0.66)	[0.11]	–
Any age	0.69	(0.23)	[0.00]	–

Note: This figure shows results from four regressions. The top panel uses data on occupations one year after degree completion. The bottom panel uses data on occupations at age 35 or 36. The first regression in each panel shows the coefficients on dummies for age at BA attainment for a regression where the dependent variable is years are current job occupation and the reference group is high school graduates. The "any age" row shows the regression coefficient on a dummy for a BA completed at any age between 21 and 39. The sample for both regressions is non-Hispanic white males in the NLSY97 whose terminal degree is either a BA or a high school diploma.

The patterns suggest that a large contributor to the difference in lifetime earnings across age of attainment is due to differences in occupational upgrading. Regardless of age of attainment, individuals enter into similar occupations a year about completing their degree. However, the on-time completers have more time post-degree to work their way into higher-earning and higher-educated occupations. This also suggests that the pre-BA labor market experience of late completers is being discounted relative to post-BA labor market experience.

7 Conclusion

We have documented that completing a BA after the age of 23 reduces the lifetime earnings premium relative to a non-BA holder for white males in the NLSY97. The negative effect of late completion on the BA premium remains even after controlling for pre-college observables like test scores, parental income, household structure and mother's education.

The data on occupational sorting tell a story that is consistent with a jobs ladder model of the labor market. Regardless of age at attainment, one year after completing a BA, BA holders are in occupations with very similar median incomes, all of which are about 50 percent higher that that for a worker with only a high school diploma. However, age at attainment matters later in the life cycle when median income of occupations is strongly declining in age of attainment. For individuals who finished their degree after age 29, their occupation's median annual income is not significantly different from a worker of the same age but with only a high school diploma. A similar pattern holds when median annual income of the occupation is replaced by the fraction of BA's in the occupation. Notably, Bárány et al. (2023) find that age at attainment matters less for females than for the males in our sample.

Under the job ladders hypothesis, BA holders work in occupations for which work experience prior to the degree is a poor substitute for the experience post-BA. Individuals who get their BA's later in life then do not have time to catch up to their peers who finished their BA's at a traditional age. For instance, median tenure within an occupation *one year following the degree* is shorter for on-time relative to late BA earners. For on-time BA's, the short tenure could be the result of switching jobs frequently as they climb to jobs with higher wages early in their careers. The median late-BA earner on the other hand appears to remain in their pre-college occupation possibly losing out on this important opportunity for advancement. Later in life, on-time BA's have significantly longer median tenures within their occupations suggesting that they have settled into their career paths.

These results have several implications for policy. First, because age of attainment is negatively correlated with socio-economic status, age of attainment is a contributing factor to lifetime earnings disparities. Policies that aim to close lifetime earnings gaps through college enrollment need to also support *on-time* college completion.

Finally, retraining older workers is a common prescription for mitigating the unequal distribution of welfare gains across the workforce resulting from structural or policy changes (e.g., trade liberalization, skill-biased technological change, tax reforms). Our findings show that enrolling older workers in BA programs may not be the best way to improve their lifetime earnings because late-attainers do not have time to maximize the return to their degree. Instead, this suggests that specific job training from certifications or skill-specific associates degrees may be more cost effective and beneficial to the worker.

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Appendix to
"The Non-Equivalence of College Equivalents"

Dionissi Aliprantis Daniel Carroll C. Lockwood Reynolds

Figure 1 shows that the pattern of earnings decreasing with age at BA attainment is present for both means and medians of the distribution of earnings.

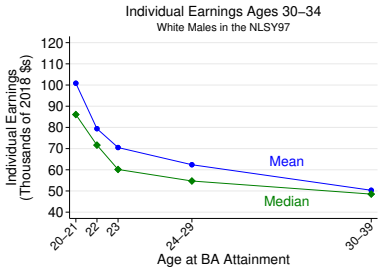
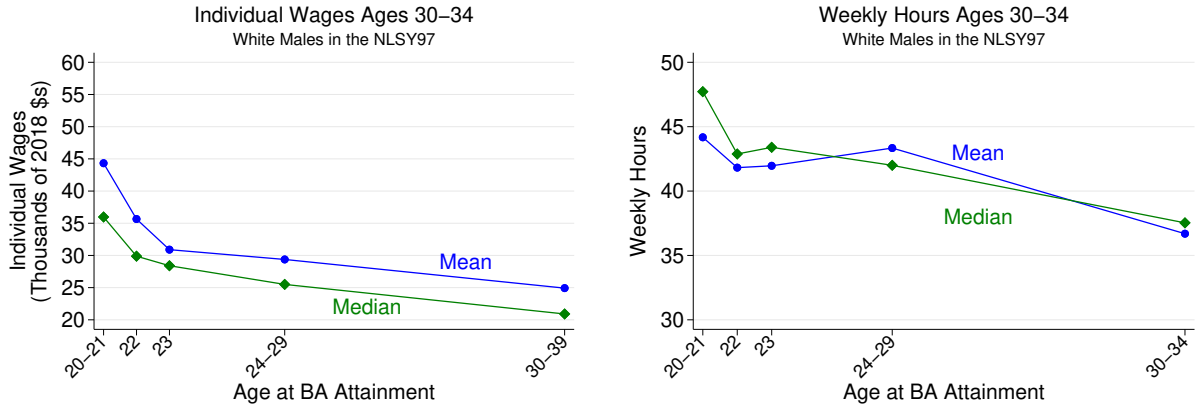


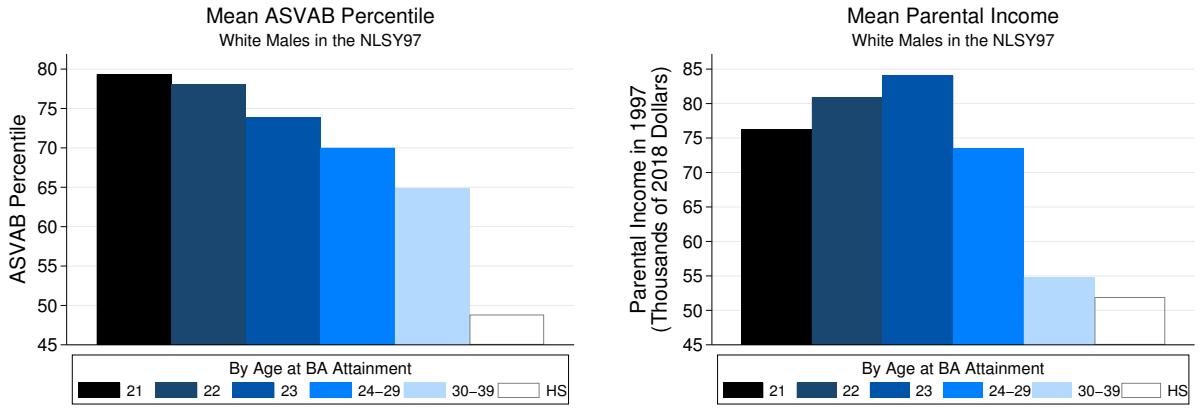
Figure 1: Mean and Median Earnings by Age at BA Attainment
Note: This figure shows the mean and median annual earnings of individuals ages 30-34 by age at BA attainment. The sample is white males in the NLSY97 whose terminal degree in the 2019 wage of the NLSY97 was a BA.

Figure 2 shows that these differences in earnings reflect differences in average wages and hours worked when ages 30-34. Figure 2a shows that wages decline monotonically in the age at BA attainment. While there is some non-monotonicity in the mean of hours worked, shown in Figure 2b, the overall pattern is one of declining hours worked in the age at BA attainment.



(a) Wages (b) Hours

Figure 2: Mean and Median Wages and Hours by Age at BA Attainment
Note: These figures show the mean and median hourly wages and weekly hours of work of individuals ages 30-34 by age at BA attainment. The sample is white males in the NLSY97 whose terminal degree in the 2019 wage of the NLSY97 was a BA.



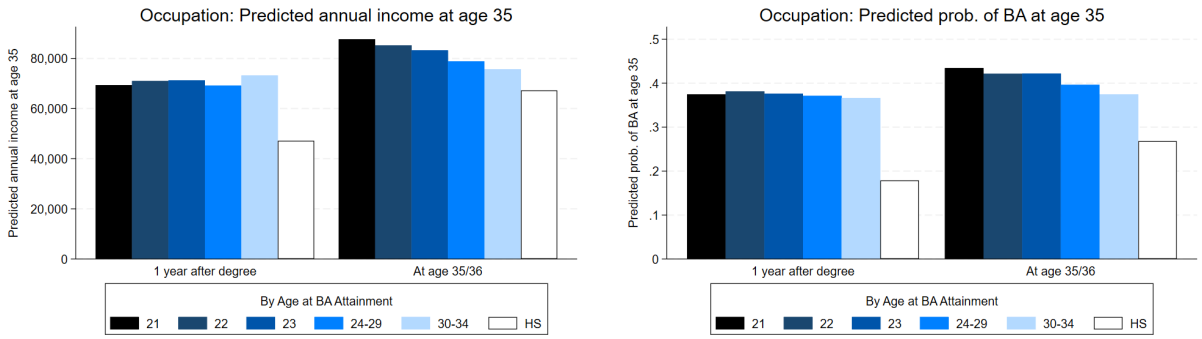
(a) Test Score Percentile

(b) Parental Income in 1997

Figure 3: Observable Characteristics by Age at BA Attainment

Note: This figure shows the mean value of some observable characteristics by age at BA attainment. The left panel shows average test score percentile on the Armed Services Vocational Aptitude Battery (ASVAB) taken when aged 12 to 16. The right panel shows the average parental income in adolescence, as measured in the 1997 survey.

Figure 4 recreates Figures 7 and 8, showing differences in occupational income and education by age at BA attainment. Since these could both be affected by differences in the age distributions of occupations, we estimated regressions for each year of occupation in the data with occupation indicators, a cubic in age and their interaction. We then predict the average outcome (occupational characteristic) at age 35 to produce a measure of occupational income and education that is not affected by differences in ages across occupations. Doing so has no substantive effect on our estimates.



(a) pmf

(b) pmf

Figure 4: Income and Educational Attainment of Occupations, adjusted to age 35

Note: This figure recreates Figures 7 and 8 but uses occupational income and percent BA predicted at 35. Therefore, they represent occupational income and education adjusted for differences in age distributions.