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Abstract

In this paper, we extend existing models that use the NLSY 79 to document employer screening and learning by showing that the return to education and ability change with experience. Specifically, we test for and document a non-linear relationship between wages and ability as measured by the AFQT score at low levels of potential experience. For high levels of AFQT, wages appear to fall as AFQT increases. As experience increases, the relationship between wages and AFQT returns to a monotonic relationship. As a result much of the observed increase in the return to AFQT as potential experience increases is associated with a change in the shape of the relationship, and the increase in the return to AFQT at lower levels of AFQT is more modest. These results are robust using samples and models from previous papers on the subject, developing a broader sample using all waves of the NLSY 79, and analyzing the question using data from the NLSY 97. Finally, we find evidence that high AFQT workers without four years of college select into occupations that provide more training, perhaps sacrificing initial wages in order to build skills.

Key Words: Wages, Human Capital, Ability, Screening, Signaling, Learning, Statistical Discrimination, AFQT, Education, Compensating Differential, Training, Occupation, NLSY

JEL Codes: D82, D83, I24, I26, J24, J31

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The Returns to Ability and Experience in High School Labor Markets: Revisiting Evidence on Employer Learning and Statistical Discrimination

The classic model of statistical discrimination implies that education serves as a signal for unobserved ability (Spence 1973; Weiss 1995). An important paper by Altonji and Pierret (2001), here after referred to as A&P, provides evidence of statistical discrimination followed by employer learning. They use the National Longitudinal Survey of Youth (NLSY 79) to show that the return to ability as measured by the Armed Forces Qualification Test (AFQT) is near zero when workers first enter the labor market and as workers gain experience the correlation between wages and ability grows and the correlation between wages and education falls.[1] Also using data from the NLSY 79, Arcidiacono, Bayer and Hizmo (2010), here after referred to as ABH, show that ability and initial wages are unrelated for high school graduates (exactly 12 years of education), but that ability appears to influence initial wages for college graduates (exactly 16 years of education). Similarly, Lange (2007), Kahn and Lange (2014), and Dustmann, Glitz, Schonberg and Brucker (2016) provide evidence related to employers learning about worker ability. Further, MacLeod et al. (2017) show that in the country of Columbia implementation of an exit exam reduced the wage return to college reputation presumably by providing information and reducing the value of the signal.[2]

In this paper, we use the NLSY 79 to replicate the basic relationships documented in A&P and ABH showing that initial wages are unrelated to AFQT score for their samples. We then extend these models to include the square of AFQT in order to allow for a non-linear

[1] Also see earlier work on this topic by Farber and Gibbons (1996).

[2] Arteaga (2018) shows the opposite effect that workers are paid for skills at hiring. Specifically, they document a decline in the wages of graduates when course work requirements for the degree fell. Her findings could also be consistent with ABH’s finding that college reveals ability through grades and the coursework completed.

relationship between ability and wages. These models suggest that ability is related to initial wages, but in a non-linear manner with wages declining with worker test score for above average test score workers. Next, we document how this non-linear relationship changes over time by estimating models of worker average wages for four year periods of potential experience. For between 1 and 4 years of potential experience average wages continue to exhibit a negative relationship with AFQT for above average AFQT scores. However, for later years of potential experience, the non-linear relationship begins to disappear, and a monotonic relationship between potential experience and AFQT develops.[3] These findings appear more consistent with Fang (2006) who attributes most of the return to education to skills, as opposed to signaling.

The documented non-linear relationship with AFQT is quite robust. We use all available waves of the NLSY 79 to examine wages of a broader sample of workers without four years of college encompasses both the A&P and ABH samples and uses the worker's initial level of education. We then repeat this exercise using the NLSY 1997. Again both using all waves of the NLSY 79 and using the NLSY 97, we continue to observe a non-linear relationship between AFQT and wages at low levels of potential experience that becomes monotonic, or at least closer to monotonic in the NLSY 97, as potential experience increases. In terms of returns to education, the evidence of declines in the return to education from years of potential experience is significantly weaker and less robust in the NLSY 79 after allowing for this non-linearity, while the NLSY 97 estimates suggest an increasing return to education with potential experience. The non-linear relationship between AFQT and wages is also robust to adding controls for sibling wage as developed in A&P, allowing for non-linear returns to education, and finally is

[3] Consistent with ABH, we observe a strongly monotonic relationship between AFQT and wages for both individuals with exactly 16 years of education and individuals with 16 or more years of education over all levels of potential experience.

concentrated primarily among white workers when the sample is split by race following Pinkston (2006).

In trying to explain these findings, we speculate that, just as high ability workers tend to attend college postponing earnings early in life for higher earnings later, perhaps high ability workers who do not obtain four years of college follow a similar pattern by taking jobs that pay less now, but contribute to the accumulation of human capital over time. To examine this premise, we estimate models related to the training received by workers early in their work career. High AFQT workers who do not initially complete four years of college are both more likely to receive firm providing training and more likely to select initial occupations that tend to provide more firm training. We also conduct analyses that rule out two alternative mechanisms. First, if workers expect to go back to college, they may place a lower priority on pre-college job search and work effort in that pre-college job. We examine our models separately based on whether the worker expects to be in college five years after the first wave of the NLSY 79, but the estimated non-linearity appears quite similar between the two subsamples. Finally, we worry that high AFQT individuals who do not complete four years of college may represent a heavily selected sample. In order to test for this, we re-estimate the wage models spitting our sample of workers without four years of college into terciles based on the likelihood of completing four years of college, but we find that the non-linearity is strongest in the least selected bottom tercile.

Replication and Initial Evidence on Non-linearities

The models and samples differ between A&P and ABH. A&P defines potential experience based on the traditional definition of age minus years of education minus six, while ABH follows Lange (2007) by calculating potential experience based on the first year that the individual leaves school and participates in the labor market. As a result, A&P contains approximately four hundred additional workers for whom ABH cannot calculate potential experience because either the individual did not report a graduation year or did not provide sufficient information on work history prior to wave 1 of the NLSY. On the other hand, the ABH sample contains approximately 1,100 workers that are not in A&P in part because ABH includes additional waves of data and A&P requires that the individual report labor market work as their primary activity at some point in order to be included in the sample.[4] While the samples are similar, one can view the A&P sample as more homogenous in potential experience because workers must have completed their initial spell of education and entered the labor market sufficiently to report work as their primary activity by the time of their study, and obviously the ABH sample is more homogenous over education.[5] The model specifications differ as well: A&P includes the interactions of AFQT, years of education and race with a cubic or third order polynomial trend for calendar year and fixed effects for the two digit occupation code of the worker's job, while ABH includes controls for region and whether the worker is employed part-time. Both models also include year fixed effects.

Due to the differences between the model specifications and the samples, we examine both samples under a variety of model specifications. The basic model of wages (y_{it}) for worker *i* in survey year *t* can be written as

$$y_{it} = S_{it}\beta_1 + (S_{it} * P_{it})\beta_2 + X_{it}\beta_3 + \delta_t + \sum_{n=1}^{N}(S_{it} * t^n)\gamma_n + \varepsilon_{it} \qquad (1)$$

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[4] Both samples include wage information from non-Hispanic male respondents ranged from 14 years old to 21 years old at the time of the first wave of the NSLY for all waves available at the time of the study, except that ABH restricts themselves to workers with 13 or less years of potential experience citing a non-linearity in the wage relationship for higher levels of potential experience. A&P restricts the sample to those who have completed 8 years or more of education with the highest possible education level recorded at 20 years, while ABH examines workers with exactly 12 or 16 years of education.

[5] These restrictions naturally lead to similar samples because workers who pursue college education are less likely to be observed in the labor market during the early waves of the NLSY available to A&P. In fact, only 15% of the A&P sample of worker wages is associated with workers with four years of college or more.

where S_{it} is the vector of skill variables composed of AFQT, possibly the square of AFQT, years of education and the race dummy variable, P_{it} is years of potential experience, X_{it} is the vector of additional controls, δ_t represents the year fixed effects, and *N* is the order of the polynomial interactions in survey year.

Table 1 Panel 1 replicates the A&P analysis while varying the year trend interactions. Column 1 excludes the year trend interactions only controlling for year fixed effects. Column 2 interacts AFQT, years of education and the race dummy with a linear year trend, and columns 3 and 4 include the same interactions with quadratic or cubic year polynomials, respectively. The year trends are initialized to zero in 1980, the year where the most individuals in the sample have 1 year of potential experience. The replication indicates a near zero return to AFQT at one year of potential experience, a falling return to education with potential experience, and an increasing return to AFQT with potential experience, but the magnitude of this last estimate is much smaller in the model with trends.

Table 1 Panel 2 includes the square of AFQT allowing for a non-linear relationship, and Panel 3 also includes the interaction of this square term with potential experience. The coefficient on the square of AFQT is sizable and negative with a near zero estimate on the linear term for AFQT, consistent with declining wages with AFQT for workers with above average AFQT scores at very low levels of potential experience since AFQT is standardized with a mean of zero. The increasing return to AFQT with potential experience is not robust to the inclusion of both the year trend interactions and the squared term for AFQT. Also, the declining return to education falls in magnitude with the inclusion of the squared term for AFQT when the model includes the year trend interactions. Finally, the interaction of the square of AFQT with potential experience is very noisy.

Table 2 Panel 1 replicates ABH with column 1 using the same subsample with exactly 12 years of education, and column 2 presenting results using a broader sample of anyone with less than four years of college (less than 16 years of education). Columns 3 and 4 replicate the analyses using the controls from A&P with the ABH sample except for the inclusion of the cubic year trend interacted with AFQT, years of education and race, and columns 5 and 6 also add the A&P year trend interactions. The increasing return to AFQT with potential experience is larger than the A&P estimate based on the full sample, and is very similar in magnitude across the models except for column 6 that includes both the year trend interactions and uses the broader sample, where the resulting estimates on the interaction between AFQT and potential experience are smaller and close in magnitude to the A&P estimates. Columns 2, 4 and 6 illustrate a negative relationship between potential experience and the returns to years of education that while noisy is similar in magnitude to the estimates of A&P.[6]

Panels 2 and 3 repeat these analyses adding the square of AFQT as a regressor and in the case of panel 3 also adding the interaction of potential experience and the square of AFQT. As in the re-analysis of the A&P sample, we find a robust negative coefficient on the square of AFQT suggestive of falling wages with AFQT for workers who have high levels of AFQT.[7] As in Table 1, the positive relationship between potential experience and the wage return to AFQT is not robust to including both year trend interactions and a non-linear relationship between wages and AFQT. The coefficient estimates on the interactions of potential experience with both years

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[6] Neither of the coefficients on AFQT or education interacted with potential experience are robust to the inclusion of the year trend interactions for the ABH sample once individuals with four years of college or more are included. A key reason for this difference between the results for the ABH and A&P sample is the inclusion of later waves of the NLSY in ABH allowing more time for individuals to complete 16 years of education and enter or re-enter the labor market.

[7] As in ABH, we do not find any evidence of increasing return to AFQT or decreasing return to education with potential experience in samples of workers with either 16 years of education or 16 or more years of education. Further, we do not find any evidence of non-linear returns to AFQT in these four years of college samples. The pooled sample tends to provide estimates that are between the estimates arising from the two subsamples

of education and AFQT are similar to Panel 1, except in the model with year trend interactions where the coefficients on the interactions with AFQT are smaller and insignificant. As in Table 1, the non-linear relationship between wages and AFQT is very robust to alternative model specifications.[8]

The near zero estimate on the linear AFQT term at one year of potential experience in both Tables 1 and 2 suggests that initially the wage return to AFQT is negative for workers with an above average AFQT score. Further, even with an insignificant estimate on the interaction of potential experience and the square of AFQT, the non-linear relationship between AFQT and wages may be changing over potential experience because the estimate on the linear AFQT term increases with experience in some models moving the value of AFQT where wages have the maximum expected value to the right. In order to examine this more carefully, we divide the sample into observations with a similar number of years of potential experience: 1-4, 5-8, 9-12, 13-16; and then to reduce noise and measurement error we collapse the data to the worker level in order to measure average wages at different levels of potential experience. A four year window was selected in order to provide at least the potential for two years of wage data, i.e. years in which the individual was surveyed and working, even once the NLSY changed from annual surveys to surveys every two years. This average wage is then regressed upon the controls for AFQT, square of AFQT, race and the within worker average for the subsample of the time varying controls in the A&P or ABH models including years of education. For the ABH model, we simply estimate a separate model for each potential experience subsample reporting robust standard errors because each subsample has only one observation per worker.

[8] All results are robust to using interactions with linear, quadratic or fourth order polynomial year interactions.

The inclusion of the cubic year trend interactions for the A&P model requires a pooled estimation of all subsamples so that all models are conditional on the same set of year trend interactions. Then, all other controls are interacted with dummy variables for each potential experience subsample. The resulting model of wages (y_{it}) for worker *i* in survey year *t* can be written as

$$y_{ip} = \sum_{p=1}^{P}\left(S_i\beta_{1p} + \bar{X}_{ip}\beta_{2p}\right) + \bar{\delta}_{ip}\beta_3 + \sum_{n=1}^{N}\left(S_i * \overline{(t^n)}_{ip}\right)\gamma_n + \varepsilon_{it} \qquad (2)$$

where p indexes the information over potential experience subsample, P is the number of potential experience subsamples, S_i is the year invariant vector of skill variables including initial education upon entering the labor market, $\bar{X}_{ip}$ is the vector of mean of X_{it} averaged over all years includes in the potential experience subsample for worker i, $\bar{\delta}_{ip}$is the mean of the binary year indicator δ_t based on averages for worker *i* in potential experience subsample *p*, and $\overline{(t^n)}_{ip}$ is the mean of each survey year polynomial variable t^n after the year initialization.

We estimate this model multiple times using different initializations for the year trend. Specifically, year is initialized to zero for the year in which the most individuals had the initial potential experience level for each interval, i.e. 1 year, 5 years, 9 years and 13 years for the four subsamples. The AFQT coefficient in each subsample and column is reported based on that subsample's initialization.[9] In this way, the quadratic expression for AFQT is indicative of the return to AFQT for the years in which that subsample worked. On the other hand, the estimates on years of education are always presented based on the one year of potential experience initialization, where year is set to zero in 1980, so that they can be compared to each other allowing us to observe whether the return to education declines with potential experience regardless of the year worked.

[9] Naturally, the estimate on the AFQT quadratic term is unaffected by the initialization.

Table 3 presents these results. For both the A&P and ABH samples/models, we continue to find strong evidence of a non-monotonic relationship between wages and AFQT and a low initial return to AFQT when workers have little potential experience. As potential experience increases, the coefficient on the linear term for AFQT increases in magnitude leading to a more monotonic relationship between wages and AFQT. The row labelled "turning point" shows the AFQT score where the slope of the relationship with wages is zero, and this turning point increases with potential experience. The slope changes are illustrated by Figure 1 Panels 1 and 2, which plot the estimated quadratic relationship between wages and AFQT for the A&P and ABH models, respectively. Both Panels show a humped shape relationship between wages and AFQT for low levels of potential experience that slowly approaches a more linear relationship as potential experience increases.[10] While the return to AFQT at low levels of AFQT does appear to increase with potential experience, much of the increase in return to AFQT over the entire range of AFQT arises from the change in the shape of the curve, rather than an increase in the steepness over that range.

Finally, the estimated coefficients on years of education fall by about one percentage point between the sample for 1-4 years and 9-12 years of potential experience, as compared to declines of about two percentage points over 10 years based on estimates in panel 1 of Tables 1 and 2. The effect of education continues to fall for 13-16 years of potential experience in the A&P sample and model, but increases somewhat for years 13-16 in Panel 2. It should be noted, however, that the cubic year trends interactions in the A&P model lead to substantially larger

[10] Qualitatively similar results arise if the AFQT coefficient is always based on year trends initialized to 1980, but the turning point in the wage relationship with AFQT does not increase as quickly with potential experience.

standard errors for the later years of potential experience subsamples because the year variable is initialized to 1980 based on the distribution of workers with one year of potential experience.[11]

We then conduct a series of robustness tests that are detailed in the appendix. A&P examine an alternative measure of ability, sibling wage, and find similar relationships between wage returns and potential experience. Our non-linear relationship between the wages and AFQT is robust to the inclusion of controls for sibling wage. In fact, the estimate on sibling wage is very stable as the AFQT controls are added. So, these results might be interpreted as finding a robust non-linearity on the wage return to cognitive skills even after controlling for a relatively independent measure of skills.[12] Following Pinkston (2006), we also estimate models separately by race. The non-linear relationship between wages and AFQT is again very robust for the white subsample. The estimates on the non-linear term for 1-4 years of potential experience are smaller and insignificant in the black sample.[13] Next, some economists have informally raised concerns about the years of education sample restrictions in ABH, namely restricting the sample to those with exactly 12 or 16 years of education. So, we estimate a model with the full ABH sample unrestricted on years of education allowing for the non-linear relationship for AFQT to differ by whether individuals have completed four years of college or not.[14] Again, the non-monotonic

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[11] If we allow the education estimates to be based on the initialization for the specific subsample in the A&P sample and model, we do not observe any decline in the return to education over potential experience in the A&P sample. Next, Appendix Table 1 presents estimates for the sample with 16 or more years of education. We do not observe the non-linear relationship between wages and AFQT, and we do not observe a declining return to education with potential experience for this sample.

[12] While the wage return to sibling wage increases in importance as we move from the 1-4 years of potential experience subsample to the 5-9 years subsample. We do not observe a decline in the return to years of education as potential experience increases, inconsistent with the signaling through education for the skills measured by sibling wage. See Appendix Table 2. Finally, we do not present models including the square of sibling wage because estimates on the square are always insignificant and unlike with AFQT including the square term also leads to very noisy estimates on sibling wage effects in general.

[13] Again, we find little or no evidence of a decline in the return to years of education for the white subsample. These results are consistent with Pinkston's (2006) finding that statistical discrimination on education was primarily experienced by black workers. See Appendix Table 3.

[14] If one is willing to condition on years of education as a right hand side variable, then in principle one should be willing to condition the sample on years of education as well. So, perhaps some of the concern with restricting the

relationship between AFQT and wages for low levels of potential experience is robust for the subsample without four year of college. Finally, the findings are robust to allowing the return to years of education to be non-linear.[15]

Expanding the NSLY Sample

Finally, we use all available waves of the NLSY to generate a broader sample of workers and worker wages, and then re-examine the average wage models for additional periods of potential experience. In our one major departure from A&P and ABH, we focus on the education level of the individual when they either first left school or on their wave 1 education level if they were not in school at wave 1 (initial education) in order to have a more exogenous measure of education. We follow ABH and Lange in defining potential experience as the number of years since the individual first left school, except for individuals who had already left school in which case we follow a slight modification to A&P and use age minus initial education minus six. Further, we observe that many individuals in school at wave 1 report leaving school or graduating in a later wave, and yet continue to increment their years of education by exactly one year in every following year for one or more years after the reported date of leaving school. In those cases, we set the first year of potential experience equal to the first year that years of education does not increase, and use the years of education observed in that year as the initial years of education.[16] Our sample of workers includes all non-Hispanic white and black, male

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sample based on years of education arises because employers may be using completion of specific education thresholds as a signal and the effect of these thresholds on wages is lost when the sample is restricted. Therefore, the model also includes controls for years of education, completion of at least 12 years of education and completion of at least 16 years of education plus the standard controls in the ABH model. The total returns to education appear relatively stable over years of potential experience. See discussion in appendix plus Appendix Table 4.

[15] See Appendix Table 5.

[16] Also, potential experience continues to be incremented every year even if or when individuals leave the labor market and go back to school after their initial period of labor market participation. ABH describes in the paper not incrementing potential experience when an individual leaves the labor market and returns to school, but in reviewing their code their potential experience also appears to increment every year regardless of whether the worker returns to school.

workers who have at least 8 years of education following A&P and a valid wage in at least one wave when not in school, and then we include observations for all future waves in which they have valid wages.[17]

We then estimate wage models at different levels of potential experience using the subsample with initial levels of education less than 16 years. We follow ABH controlling for part-time work, urban area and region averaging over all survey years included in each potential experience subsample and where the individual had a valid wage. We estimate models both with and without the A&P interactions of AFQT, years of education and race with the cubic year trend. The models with those interactions are pooled across the potential experience subsamples, while the models without the interactions are estimated separately for each subsample, following the structure in Table 3. We select the year for initializing the year trends to zero based on the center of the three highest years in terms most workers with 1, 5, 9, etc. years of potential experience. By using the mode year plus the next two highest years, we substantially reduce the variation in the initialization year across subsamples.[18] We drop the occupation controls because occupation has been documented to capture a substantial amount of information on ability (Bacolod and Blum, 2010).

Table 4 Panel 1 presents the estimates for the model with the year trend interactions, and Panel 2 presents the same model estimates for the white subsample given the differences

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[17] These criteria broaden our sample relative to both A&P and ABH, like ABH including workers whether or not they report work as their primary activity and like A&P not requiring as much information on graduation year or work history for those in the labor market in wave 1. We also follow A&P so that if the wage rate with the most recent job is invalid we use other wage rates that the workers have reported in this wave of the survey, while ABH deletes observations when the wage in the most recent job is invalid. Our final sample includes virtually every observation included in either ABH or A&P, as well as an additional 700 workers who were in neither sample.

[18] In cases where there are ties in the number of workers in determining the three highest years, we resolve this by using the center of the five highest years. Again, the initializations cannot have any influence on the coefficient estimate or standard error for the square of AFQT. In terms of Table 3, using the three highest years would also have yielded 1980 as the base year.

between whites and blacks described above. Each column presents estimates for average wages for four specific years of potential experience up to 29 to 32 years. The base year for 1-4 years of potential experience is 1981, and the base year tends to increase by between 3 to 5 years across each potential experience bin. Figure 2 Panels 1 and 2 present plots of the estimate relationship between wage and each level of AFQT. The non-monotonic relationships in Figure 2 for low levels of potential experience are robust and very similar to the plots in Figure 1. In both panels, a substantial portion of the increasing return to AFQT with potential experience is attributable to the changes from a non-monotonic to a monotonic relationship between AFQT and wages. In fact, for the white sub-sample (panel 2), the slope of the AFQT-wage curve for 1-4 years of potential experience is virtually indistinguishable from the curves for higher levels of potential experience at low levels of AFQT. Table 4 Panels 3 and 4 present the estimates for the same samples and models excluding the year trend interactions, and the coefficients on AFQT and the square of AFQT are very similar across the panels.

The white sample estimates show a larger non-linearity in AFQT and the lack of any substantial increase in the AFQT slope over potential experience for low levels of AFQT and potential experience. These findings are consistent with Pinkston's (2006) failure to find much evidence of employers using education as a signal or learning in the white subsample of the NLSY. Further, the concentration of evidence for statistical discrimination in the black subsample is also consistent with Lang and Manove's (2011) finding that blacks are over-represented in higher education conditional on ability, and ABH's argument that a potential explanation for the selection of blacks into higher education is their desire to avoid discrimination by revealing ability through success in college.[19]

However, key differences exist across the panels between the various estimates for years of education. Turning back to Table 4, the parameter estimates on education for the sample with whites and blacks in the trends model (Panel 1) fall steadily with potential experience reaching only 2 percentage points per year and becoming insignificant by 21-24 years of potential experience. For the white subsample, the return to education is relatively stable through 17-20 years ranging between 6 and 7 percent wage gains per year of education, and then declines to 5 percent per year by 29-32 years of potential experience. However, it is important to remember that the standard errors have increased substantially to 3 percentage point for the 29-32 years subsample. Turning to the models with no year trends, Panels 3 and 4, the estimates on years of education are very stable in magnitude over potential experience. Therefore, the only solid evidence for declining returns to education with potential experience is in the full sample that contains a substantial number of black workers, and notably the black subsample does not exhibit the same non-linearity between wages and AFQT.[20]

Next, we create a comparable sample using workers for the NLSY 1997 and imposing the exact same sample restrictions described above. Table 5 presents estimates of the return to AFQT for workers with less than four years of college and 1-4, 5-8, 9-12 and 13-16 years of

[19] Similarly, Bjerk (2007) finds that ability explains the entire black-white wage gap for workers in white collar jobs, while wage gaps persist in blue collar jobs, and that conditional on ability blacks are more likely to work in white collar jobs.

[20] Appendix Table 6 presents the estimates for the subsample of workers who have 4 years of college or more. We find no evidence of a non-linearity between wages and AFQT. We find an increasing return to AFQT over time, but we do not find evidence of falling return to years of education. These findings appear more consistent with a complementarity between ability and potential experience among college graduates. Findings are also consistent with Deming and Noray (2018) who find a strong correlation between ability and receiving a STEM degree creating the potential for statistical discrimination, but in terms of wages find that most of the initial STEM degree wage premium arises only when actually working in STEM concluding that the wage premium is compensation for STEM skills learned in college.

potential experience using data from the NLSY 1997. The estimated AFQT coefficients are also illustrated in Figure 3. For low levels of potential experience between 1 and 8 years, the relationship between AFQT and wages is clearly negative for the upper half of the AFQT distribution, but as in Table 7 this negative relationship begins to weaken and reverse as potential experience increases. Appendix Table 7 presents results similar to the interactive models in Tables 1 and 2 for the NLSY 97. As above, the non-linearity between AFQT and wages is relatively robust, but like Castex and Dechter (2014) we do not find evidence consistent with statistical discrimination followed employer learning in the NSLY 97 for either our full sample or the sample with less than four years of college.[21]

In summary, neither broadening the sample, adding information from the additional waves of data, or using data from younger cohorts in a later time does anything to change our basic conclusions. First, the return to AFQT is non-monotonic for low levels of potential experience for workers without four years of college and much of the increase in the average return to potential experience can be attributed to the shift toward a more linear relationship as potential experience increases. Second, the declines in the return to education with potential experience tend to be more modest in magnitude and much less robust than those identified by A&P.

Mechanisms

It is well accepted that high ability workers tend to attend college, postponing earnings early in life in exchange for building human capital, and so receiving higher earnings later in life.[22] Perhaps, high ability workers who do not go to college follow a similar pattern by taking

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[21] Appendix Table 8 shows the estimates for models equivalent to those presented in Table 5 except that it does not include year trend interactions. The results are very similar to those in Table 5.

[22] See Fang (2006) for example.

jobs that pay less now, but contribute to the accumulation of human capital over time and so higher wages later in life. In order to examine this possibility, we look at training provided by firms. Kahn and Lange (2014) show that a substantial portion of wage dispersion is attributable to worker learning and associated productivity gains. If learning is facilitated by cognitive ability, high AFQT workers may prefer jobs that convey substantial skills over time, especially if they have not invested in such skills through higher education.

We develop an intensity measure of training as the fraction of years in the labor market in which an individual received training during the first four years after entering the labor market. We regress this measure for our sample of workers with less than 16 years of education controlling for the standard controls from our model specification in Table 4 with one exception. We only interact AFQT, initial education and race with linear trends for the year the individual entered the labor market because when focusing on early years of labor market participation the sample has much less range over survey years. These results are shown in columns 1 and 2 of Table 6 with column 1 presenting results for firm sponsored training and column 2 presenting results for firm sponsored training plus apprenticeships. A one standard deviation change in AFQT is associated with an increase in the intensity in share of years receiving training of between 1/3 and 1/2 of the average intensity of training experienced in the sample.

Next, we use the entire sample of NLSY 1979 workers in order to identify the industries and occupations where firm sponsored training or apprenticeships are most common. Specifically, we calculate the average intensity of training received during the first four years of work for the entire NLSY sample of male of workers, relaxing many of the sample restrictions placed on our regression sample, and then calculate the training intensity by industry and occupation. We assign workers in our regression sample to a training intensity based on their initial job's industry or occupation omitting themselves from the calculation of intensity for their industry and occupation. Columns 3 and 4 present results where the dependent variable is the average intensity of training during first four years for the individual's initial industry, and columns 5 and 6 use a similar measure based on initial occupation. Higher AFQT workers appear to select into occupations that provide more training. A one standard deviation increase in AFQT is associated with an initial occupation choice into occupations where average training intensity is 10 percent higher than the intensity observed in the average training intensity occupation.

We investigate two other potential mechanisms for the non-linear relationship between initial wages and AFQT for workers who do not complete four years of college. The second mechanism is based on the premise that if workers expect to go back to college, they may place a lower priority on pre-college job search and work effort in that pre-college job. In Appendix Table 9, we split the sample for the early wage regressions based on self-reported expectation of being in college five years after the first wave of the NLSY 79, and plots of the estimated non-linear relationship are shown in Appendix Figure 1. The non-linear relationship is very similar between the two subsamples.

The final potential mechanism is selection into the sample of workers with less than four years of college. Perhaps, the non-linear relationship arises because high AFQT individuals who do not complete four years of college are negatively selected reducing their wages, and the highest AFQT workers are most selected and so have the lowest wages. Appendix Table 10 and Appendix Figure 2 present estimates of the return to AFQT for early wages by subsamples based on terciles of the probability of completing four years of college drawn from the sample without four years of college. The highest tercile should be the most selected, and yet the non-linear relationship between AFQT and wages is strongest for the bottom tercile where selection is negligible with over 97 percent of the sample not having four years of college. The non-linearity similar between the middle and top terciles even though the top tercile sample is far more selected.

Discussion

In summary, the signaling model of educational investment is a very important theory within labor economics, and much of the evidence in support of this theory is based on analyses of the 1979 National Longitudinal Survey of Youth where initial wages have been found to be unrelated to a test score proxy for ability, but to increase with test score based on time in the labor market, while simultaneously the importance of education in explaining wages falls with time. In this paper, we show that AFQT is related to early wages for high school graduates who did not complete four years of college, but in a non-linear manner with wages rising with AFQT for workers with low scores and falling with AFQT for workers with high scores. This non-linear relationship disappears as workers obtain more experience. These patterns are very robust across samples and model specifications, and a substantial portion of the increase in the return to AFQT with potential experience in the NLSY is likely due to the short-run nature of this non-monotonic relationship. Further, as previously observed by Pinkston (2006), almost all of the evidence that we identify for declining returns to education with potential experience is not present in a model that excludes black workers.

The evidence appears consistent with the highest ability workers who do not complete four years of college investing in higher future earnings by selecting jobs that build human capital. High school graduate workers with high AFQT are observed to receive more training than low AFQT workers and to select into occupations where training is provided more frequently. It is important to note that when just focusing on low AFQT workers the return of

AFQT in wages does increase with potential experience in some models. Further, the wage returns associated with higher sibling wages also increase with potential experience. Therefore, statistical discrimination may still play a role in explaining the early wages of workers, but past studies that have not considered compensating wage differentials based on future skill accumulation likely significantly overstate the importance of signaling for demonstrating cognitive skills in the labor market.

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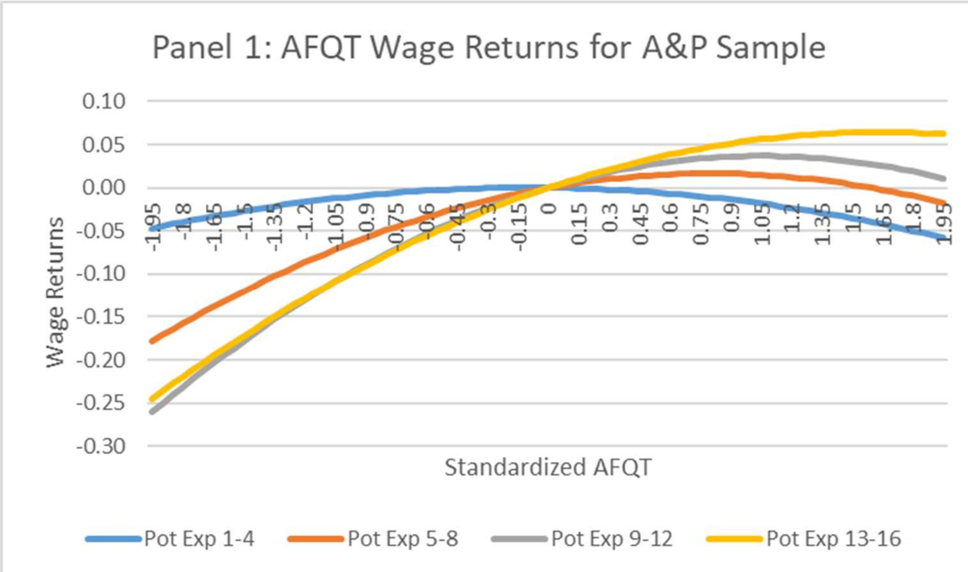
Figure 1. Estimated Relationship between AFQT and Average Wages



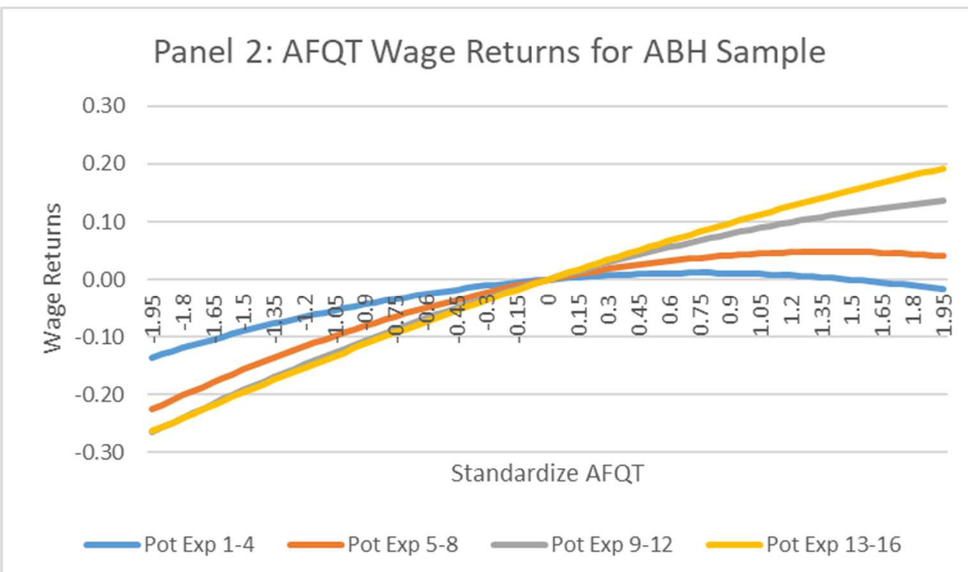


Figure 2. Preferred Sample Relationship between AFQT and Average Wages

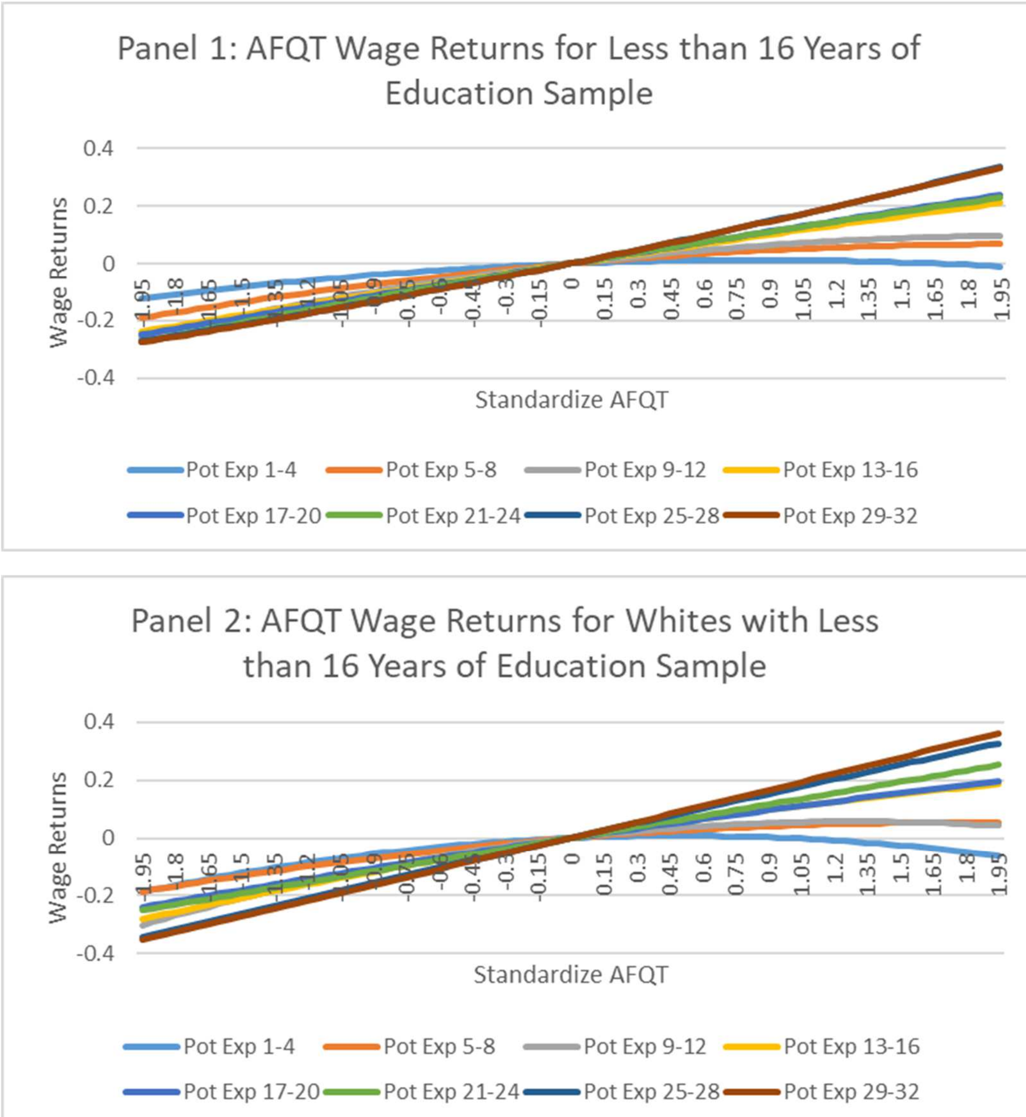


Figure 3. NLSY 1997 Relationship between AFQT and Average Wages

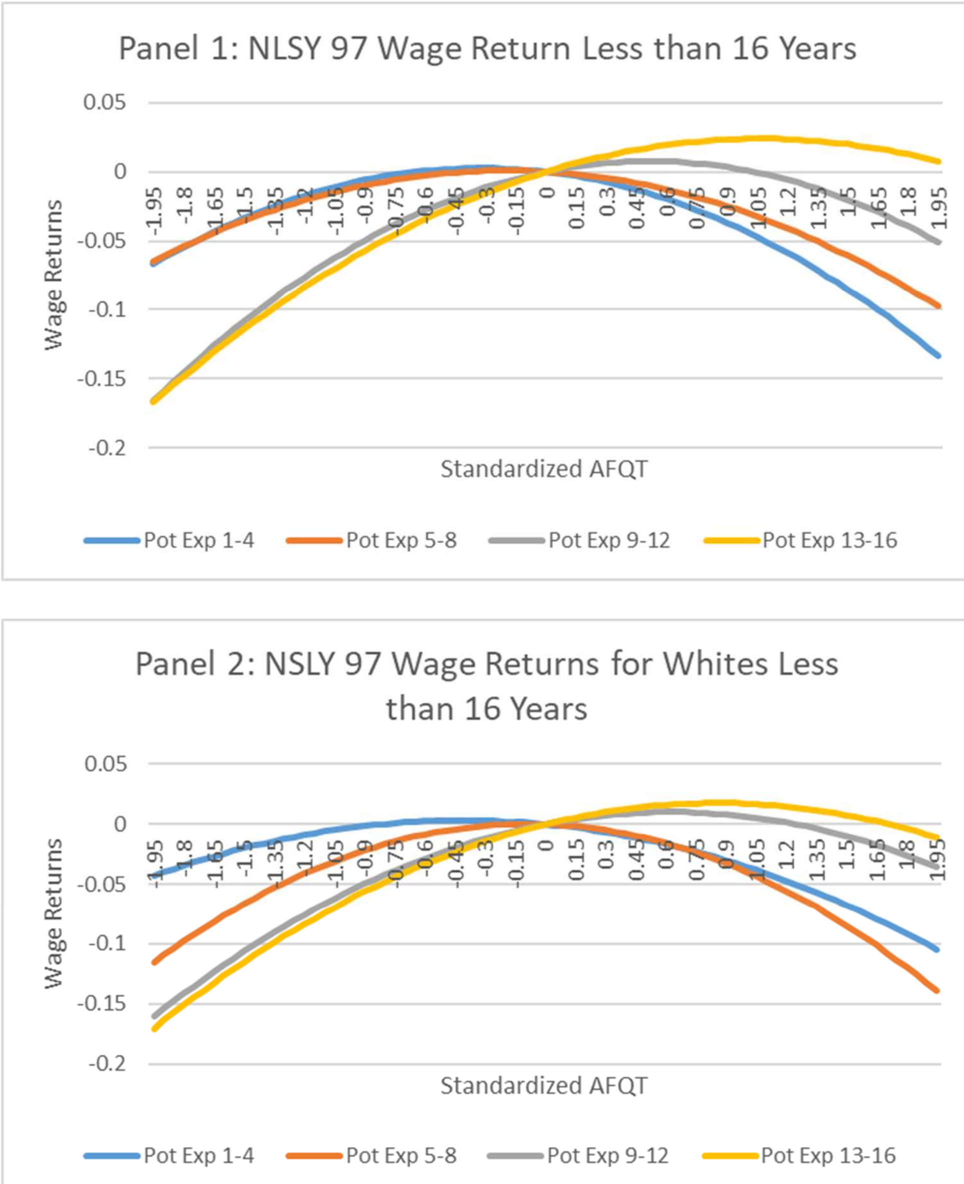


Table 1 Altonji and Pierret Replication and Non-linear Returns to Ability

Trend-Human Capital Interactions	None	Linear	Quadratic	Cubic
Panel 1: Replication				
AFQT	0.00524	0.00114	-0.0210	-0.0118
	(0.0118)	(0.0111)	(0.0133)	(0.0135)
AFQT*Pot Exper/10	0.0850***	0.0465	0.0532	0.0515
	(0.00161)	(0.00337)	(0.00342)	(0.00343)
Years Education	0.0724***	0.0687***	0.0737***	0.0797***
	(0.00656)	(0.00643)	(0.00753)	(0.00777)
Years Ed*Pot Exper/10	-0.0176**	-0.0175	-0.0191	-0.0193
	(0.000813)	(0.00126)	(0.00127)	(0.00127)
Observations	21,058	21,058	21,058	21,058
R-Squared	0.286	0.287	0.287	0.287
Mean of Wages	8.23	8.23	8.23	8.23
Panel 2: Non-linear Returns to AFQT				
AFQT	0.00378	-0.00469	-0.0253*	-0.0167
	(0.0119)	(0.0115)	(0.0134)	(0.0136)
AFQT^2	-0.0169***	-0.0247***	-0.0246***	-0.0243***
	(0.00590)	(0.00658)	(0.00659)	(0.00659)
AFQT*Pot Exper/10	0.0726***	-0.00491	0.00171	6.17e-04
	(0.00161)	(0.00369)	(0.00376)	(0.00376)
Years Education	0.0741***	0.0703***	0.0747***	0.0807***
	(0.00658)	(0.00643)	(0.00751)	(0.00775)
Years Ed*Pot Exper/10	-0.0179**	-0.0130	-0.0144	-0.0147
	(0.000814)	(0.00127)	(0.00128)	(0.00128)
Observations	21,058	21,058	21,058	21,058
R-Squared	0.287	0.289	0.289	0.289
Panel 3: Non-linear Returns Evolving Over Time				
AFQT	0.00764	-0.00113	-0.0218	-0.0130
	(0.0126)	(0.0120)	(0.0142)	(0.0144)
AFQT^2	-0.0104	-0.0188**	-0.0195**	-0.0190**
	(0.00849)	(0.00868)	(0.00871)	(0.00870)
AFQT*Pot Exper/10	0.0659***	-0.0103	-0.00300	-0.00431
	(0.00186)	(0.00382)	(0.00391)	(0.00391)
AFQT^2*Pot Exper/10	-0.00929	-0.00835	-0.00711	-0.00743
	(0.00110)	(0.00109)	(0.00111)	(0.00110)
Years Education	0.0735***	0.0698***	0.0744***	0.0803***
	(0.00660)	(0.00646)	(0.00753)	(0.00776)
Years Ed*Pot Exper/10	-0.0171**	-0.0125	-0.0140	-0.0143
	(0.000819)	(0.00128)	(0.00129)	(0.00129)
Observations	21058	21,058	21,058	21,058
R-Squared	0.287	0.289	0.289	0.289

Notes: Panel 1 replicates the reduced form results in potential experience from Altonji and Pierret. Panel 2 adds a control for the square of AFQT, and Panel 3 adds controls for both the square of AFQT and its interaction with potential experience. Column 1 presents the model with just year fixed effects, while columns 2-4 present estimates for a model with AFQT, years education and race interacted with a year linear, quadratic polynomial and cubic polynomial trends, respectively. Year trends are initialized to zero at 1980, the year in which the most individuals in the sample had their first year of potential experience. Standard errors are clustered at the individual worker level.

Table 2 ABH Replication and Non-linear Returns to Ability

Model	ABH		A&P w/out HC Interactions		Cubic HC Interactions	
Sample: Years of Education	12 Years	Less than 16	12 Years	Less than 16	12 Years	Less than 16
			Panel 1: Replication			
AFQT	0.008	0.011	0.00294	0.00658	0.00113	0.00267
	(0.013)	(0.011)	(0.0124)	(0.0104)	(0.0150)	(0.0117)
AFQT*Pot Exper/10	0.118***	0.105***	0.121***	0.107***	0.0910*	0.0617*
	(.017)	(0.014)	-0.0176	-0.0143	-0.0465	-0.0366
Years Education	--	0.064***	--	0.0495***	--	0.0565***
	--	(0.007)	--	(0.00698)	--	(0.00788)
Years Ed*Pot Exper/10	--	-0.022**	--	-0.0106	--	-0.0318
	--	(0.010)	--	-0.00968	--	-0.0218
Observations	11772	19692	11,795	19,725	11,795	19,725
R-Squared	0.19	0.20	0.214	0.224	0.215	0.225
Mean of Wages	8.51	8.66	8.51	8.66	8.51	8.66
			Panel 2: Non-linear Returns to AFQT			
AFQT	-0.000	0.007	-0.00551	0.00122	-0.00954	-0.00484
	(0.013)	(0.011)	(0.0125)	(0.0105)	(0.0152)	(0.0119)
AFQT^2	-0.035***	-0.023***	-0.0350***	-0.0284***	-0.0348***	-0.0312***
	(0.008)	(0.006)	(0.00848)	(0.00647)	(0.00854)	(0.00662)
AFQT*Pot Exper/10	0.108***	0.098***	0.111***	0.0990***	0.0736	0.0312
	(0.017)	(0.014)	-0.0173	-0.0142	-0.0462	-0.0365
Years Education	--	0.064***	--	0.0493***	--	0.0565***
	--	(0.007)	--	(0.00695)	--	(0.00787)
Years Ed*Pot Exper/10	--	-0.022**	--	-0.0107	--	-0.0307
	--	(0.010)	--	-0.00965	--	-0.0216
Observations	11772	19692	11,795	19,725	11,795	19,725
R-Squared	0.19	0.20	0.220	0.228	0.220	0.229
			Panel 3: Non-linear Returns Evolving Over Time			
AFQT	0.001	0.008	-0.00520	0.00259	-0.00953	-0.00341
	(0.013)	(0.011)	(0.0128)	(0.0108)	(0.0155)	(0.0120)
AFQT^2	-0.032***	-0.018**	-0.0341***	-0.0237***	-0.0348***	-0.0275***
	(0.010)	(0.008)	(0.00969)	(0.00791)	(0.00976)	(0.00803)
AFQT*Pot Exper/10	0.107***	0.096***	0.110***	0.0965***	0.0736	0.0296
	(0.018)	(0.015)	-0.0185	-0.0151	-0.0467	-0.0368
AFQT^2*Pot Exper/10	-0.004	-0.008	-0.00133	-0.00723	-2.64E-05	-0.00563
	(0.034)	(0.011)	-0.0142	-0.00114	-0.0143	-0.0113
Years Education	--	0.064***	--	0.0493***	--	0.0565***
	--	(0.007)	--	(0.00695)	--	(0.00786)
Years Ed*Pot Exper/10	--	-0.022**	--	-0.0107	--	-0.0308
	--	(0.010)	--	-0.00965	--	-0.0216
Observations	11772	19692	11,795	19,725	11,795	19,725
R-Squared	0.19	0.20	0.220	0.228	0.220	0.229

Notes: Panel 1 replicates the model by Arcidiacono, Bayer and Hizmo. Panel 2 adds a control for the square of AFQT, and Panel 3 adds controls for both the square of AFQT and its interaction with potential experience. Column 1 uses a subsample with just workers with exactly 12 years of education, and column 2 presents estimates for all workers with less than 16 years of education. Columns 3 and 4 present estimates for the same samples using the A&P set of controls except for the interactions of AFQT, education and race with year trends. Columns 5 and 6 modify the models presented in columns 3 and 4 by including the interactions with a cubic polynomial in year. Year trends are initialized to zero at 1980, the year in which the most individuals in the sample had their first year of potential experience. Standard errors are clustered at the individual worker level.

Table 3 Determinants of Average Wages at Different Levels of Potential Experience				
Average over Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: A&P Model and Sample				
AFQT	-0.00275	0.0413***	0.0695***	0.0786***
	(0.0115)	(0.0136)	(0.0198)	(0.0280)
AFQT^2	-0.0138**	-0.0258***	-0.0328***	-0.0240
	(0.00690)	(0.00759)	(0.00933)	(0.0166)
Years Education	0.0644***	0.0633***	0.0556***	0.0460**
	(0.00599)	(0.00786)	(0.0117)	(0.0181)
Observations	2,307	2,644	2,135	839
R-Squared	0.357			
Turning Point	-0.10	0.80	1.06	1.64
Mean of Wages	6.86	8.25	8.81	8.29
Panel 2: ABH Model and Sample w/ Education <16				
AFQT	0.0302***	0.0683***	0.103***	0.117***
	(0.0101)	(0.0105)	(0.0125)	(0.0140)
AFQT^2	-0.0201***	-0.0243***	-0.0169*	-0.00931
	(0.00780)	(0.00828)	(0.00892)	(0.00970)
Years Education	0.0530***	0.0474***	0.0432***	0.0499***
	(0.00655)	(0.00696)	(0.00715)	(0.00917)
Observations	2,406	2,549	2,200	1,802
R-Squared	0.171	0.179	0.245	0.241
Turning Point	0.75	1.41	3.05	6.28
Mean of Wages	7.26	8.53	9.60	10.41

Notes: All potential experience subsamples have one observation per worker using average wages when in the labor market as the dependent variable and using the average of time varying control variables over the same waves. Panel 1 presents estimates using the A&P model and worker sample, and Panel 2 presents estimates using the ABH model and worker sample. The A&P model in Panel 1 pools all subsamples. The model includes the interaction of AFQT, education and black with year cubic trends. All other controls are interacted with dummy variables associated with the subsamples for different years of potential experience. The AFQT estimates in each column use an initial year based on the mode year for the first year of potential experience included in the subsample. The education estimates for all columns use an initial year based on the mode year for one year of potential experience. Panel 2 presents results of a seperate regression in each subsample since their are no trend interactions. Column 1 presents the model for average wages based on observations between 1 and 4 years potential experience. Columns 2 through 4 present comparable estimates for 5-8 years, 9-12 years and 13-16 years, respectively. Standard errors are clustered at the worker level for panel 1, and robust standard errors are reported for panel 2 since there is only one observation per work in each regression.

Table 4 Incorporating Information from all Waves of the NLSY

Sample: Years of Potential Experience	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
Panel 1: Less Than 16 Years								
AFQT	0.0289***	0.0662***	0.0905***	0.115***	0.125***	0.129***	0.156***	0.156***
	(0.00937)	(0.0110)	(0.0129)	(0.0129)	(0.0138)	(0.0157)	(0.0177)	(0.0192)
AFQT^2	-0.0174**	-0.0163**	-0.0211***	-0.00362	0.00122	-0.00615	0.00864	0.00753
	(0.00740)	(0.00697)	(0.00741)	(0.00867)	(0.00949)	(0.00995)	(0.0111)	(0.0126)
Initial Years Education	0.0606***	0.0585***	0.0542***	0.0414***	0.0405**	0.0290	0.0227	0.0221
	(0.00618)	(0.00718)	(0.00977)	(0.0128)	(0.0169)	(0.0194)	(0.0220)	(0.0254)
Observations	2,768	3,468	3,215	2,789	2,435	2,267	2,125	1,944
R-Squared	0.297							
Turning Point	0.83	2.03	2.14	15.88	-51.23	10.49	-9.03	-10.36
Mean of Wages	7.33	8.54	9.58	10.46	11.60	12.42	12.86	12.72
Panel 2: Less Than 16 Years White Workers Only								
AFQT	0.0324***	0.0613***	0.0883***	0.120***	0.112***	0.129***	0.172***	0.183***
	(0.0107)	(0.0126)	(0.0151)	(0.0152)	(0.0155)	(0.0187)	(0.0214)	(0.0232)
AFQT^2	-0.0327***	-0.0176*	-0.0341***	-0.0126	-0.00559	0.000387	-0.00214	0.00161
	(0.00932)	(0.00965)	(0.0105)	(0.0126)	(0.0135)	(0.0156)	(0.0165)	(0.0181)
Initial Years Education	0.0687***	0.0685***	0.0736***	0.0627***	0.0823***	0.0656**	0.0589**	0.0479
	(0.00724)	(0.00897)	(0.0126)	(0.0165)	(0.0217)	(0.0257)	(0.0288)	(0.0332)
Observations	1,944	2,389	2,133	1,772	1,502	1,399	1,294	1,205
R-Squared	0.300							
Turning Point	0.50	1.74	1.29	4.76	10.02	-166.67	40.19	-56.83
Mean of Wages	7.55	8.94	10.27	11.42	12.72	13.82	14.50	14.27

Notes: Presents estimates for worker average wage when in the labor market over the years of potential experience identified in the column headings. Wage information from all waves of the NLSY are included. The sample is restricted to workers with less than 16 years of education in their first year of potential experience or when first observed if in the labor market in 1979. The samples in panels 2 and 4 are also restricted to only white workers. All models control for the initial years of education rather than actual education when surveyed. The columns are for worker average wages over different years of potential experience. All models include the controls from the ABH model, and the models in panels 1 and 2 include the interaction of the year cubic with AFQT, years of education and in panel 1 race. In panels 1 and 2, the AFQT estimate is based on year trends initialized for the subsample initial potential experience, and the education estimate is based on year trends initialized for one year of potential experience (1981), and standard errors are clustered at the worker level. Panels 3 and 4 present estimates from seperate regressions for each column, and standard errors are robust.

Table 4 (continued) Incorporating Information from all Waves of the NLSY

Sample: Years of Potential Experience	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
Panel 3: Less Than 16 Years without Trend Interactions								
AFQT	0.0298***	0.0705***	0.100***	0.126***	0.130***	0.137***	0.161***	0.157***
	(0.00898)	(0.00928)	(0.0104)	(0.0116)	(0.0131)	(0.0149)	(0.0167)	(0.0177)
AFQT^2	-0.0161**	-0.0142**	-0.0177**	0.00187	0.00585	-0.000387	0.0109	0.00487
	(0.00709)	(0.00673)	(0.00725)	(0.00841)	(0.00916)	(0.00971)	(0.0109)	(0.0122)
Initial Years Education	0.0629***	0.0609***	0.0655***	0.0617***	0.0685***	0.0701***	0.0638***	0.0650***
	(0.00617)	(0.00590)	(0.00596)	(0.00743)	(0.00931)	(0.00932)	(0.0100)	(0.0116)
Observations	2,768	3,468	3,215	2,789	2,435	2,267	2,125	1,944
R-Squared	0.171	0.187	0.262	0.239	0.250	0.241	0.219	0.202
Turning Point	0.93	2.48	2.82	-33.69	-11.11	177.00	-7.39	-16.12
Mean of Wages	7.33	8.54	9.58	10.46	11.60	12.42	12.86	12.72
Panel 4: Less Than 16 Years White Workers Only without Trend Interactions								
AFQT	0.0343***	0.0692***	0.0988***	0.127***	0.110***	0.125***	0.166***	0.172***
	(0.0104)	(0.0107)	(0.0120)	(0.0139)	(0.0150)	(0.0177)	(0.0204)	(0.0213)
AFQT^2	-0.0295***	-0.0156*	-0.0324***	-0.00957	-0.00509	0.00334	-0.00361	-0.00328
	(0.00901)	(0.00927)	(0.0102)	(0.0120)	(0.0130)	(0.0153)	(0.0164)	(0.0182)
Initial Years Education	0.0702***	0.0655***	0.0716***	0.0638***	0.0860***	0.0819***	0.0654***	0.0576***
	(0.00730)	(0.00719)	(0.00760)	(0.00960)	(0.0119)	(0.0123)	(0.0142)	(0.0158)
Observations	1,944	2,389	2,133	1,772	1,502	1,399	1,294	1,205
R-Squared	0.189	0.163	0.231	0.211	0.234	0.179	0.154	0.146
Turning Point	0.58	2.22	1.52	6.64	10.81	-18.71	22.99	26.22
Mean of Wages	7.55	8.94	10.27	11.42	12.72	13.82	14.50	14.27

Notes: Presents estimates for worker average wage when in the labor market over the years of potential experience identified in the column headings. Wage information from all waves of the NLSY are included. The sample is restricted to workers with less than 16 years of education in their first year of potential experience or when first observed if in the labor market in 1979. The samples in panels 2 and 4 are also restricted to only white workers. All models control for the initial years of education rather than actual education when surveyed. The columns are for worker average wages over different years of potential experience. All models include the controls from the ABH model, and the models in panels 1 and 2 include the interaction of the year cubic with AFQT, years of education and in panel 1 race. In panels 1 and 2, the AFQT estimate is based on year trends initialized for the subsample initial potential experience, and the education estimate is based on year trends initialized for one year of potential experience (1981), and standard errors are clustered at the worker level. Panels 3 and 4 present estimates from seperate regressions for each column, and standard errors are robust.

Table 5 Determinants of Average Wages over Potential Experience NLSY 97

Sample: Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: Less Than 16 Years of Education				
AFQT	-0.0171	-0.00841	0.0295*	0.0447**
	(0.0110)	(0.0145)	(0.0175)	(0.0222)
AFQT^2	-0.0263***	-0.0213**	-0.0285***	-0.0209
	(0.00690)	(0.00951)	(0.0107)	(0.0140)
Initial Years Education	0.0384***	0.0622***	0.102***	0.145***
	(0.00669)	(0.0140)	(0.0242)	(0.0337)
Observations	2,001	1,800	1,695	1,320
R-Squared	0.208			
Turning Point	-0.33	-0.20	0.52	1.07
Mean of Wages	8.97	11.30	12.67	13.89
Panel 2: Less Than 16 Years of Education White Workers Only				
AFQT	-0.0158	-0.00593	0.0322*	0.0410
	(0.0132)	(0.0159)	(0.0192)	(0.0254)
AFQT^2	-0.0194*	-0.0335***	-0.0258*	-0.0239
	(0.0101)	(0.0112)	(0.0132)	(0.0189)
Initial Years Education	0.0262***	0.0645***	0.112***	0.163***
	(0.00834)	(0.0153)	(0.0275)	(0.0383)
Observations	1,325	1,179	1,112	847
R-Squared	0.220			
Turning Point	-0.41	-0.09	0.62	0.86
Mean of Wages	9.44	11.91	13.50	15.05

Notes: Presents estimates for worker average wage when in the labor market over the years of potential experience identified in the column headings using the NLSY 1997 following the same sample selection process used to create the extended sample of workers for Table 4. Wage information from all waves of the NLSY 1997 are included. Following Table 4, the regression uses initial education and potential experience is incremented yearly after entering the labor market whether or not the individual returns to school. The sample is restricted to workers with less than 16 years of education in their first year of potential experience or when first observed if in the labor market in 1997, and further restricted in panel 2 to white workers only. The columns are for worker average wages over different years of potential experience. The models in panel 1 include the interaction of the year cubic with AFQT, years of education and in panel 1 race. The estimates are based on a pooled model with the estimates presented interacted with dummies for the potential experience subsample. The AFQT estimates are based on year trends initialized for the subsample initial potential experience, and the education estimates are based on year trends initialized for one year of potential experience, and standard errors are clustered at the worker level.

Table 6 Relationship between Training and AFQT for less than 16 Years of Initial Education Sample

	Actual Training		Average Training within Industry		Average Training within Occupation	
	Corporate Training	Plus Apprenticeships	Corporate Training	Plus Apprenticeships	Corporate Training	Plus Apprenticeships
Panel 1: Less Than 16 Years of Initial Education						
AFQT	0.0108***	0.0188***	0.00149	0.00129	0.00846***	0.00887***
	(0.00339)	(0.00448)	(0.00144)	(0.00144)	(0.00144)	(0.00155)
AFQT^2	-8.18e-05	-0.000968	0.00101	0.000582	0.00123	0.000363
	(0.00220)	(0.00285)	(0.00105)	(0.00105)	(0.00110)	(0.00115)
Observations	2,768	2,768	2,768	2,768	2,767	2,767
R-squared	0.057	0.042	0.064	0.060	0.146	0.122
Mean of Dependent Variables	0.03	0.04	0.09	0.10	0.07	0.08
Panel 2: Less Than 16 Years of Initial Education White Workers Only						
AFQT	0.0127***	0.0222***	0.00208	0.00198	0.00818***	0.00890***
	(0.00371)	(0.00507)	(0.00160)	(0.00162)	(0.00145)	(0.00163)
AFQT^2	-0.000784	-0.00138	0.000288	-0.000334	0.00140	0.000334
	(0.00293)	(0.00377)	(0.00129)	(0.00129)	(0.00130)	(0.00139)
Observations	1,944	1,944	1,944	1,944	1,943	1,943
R-squared	0.051	0.038	0.057	0.056	0.141	0.111
Mean of Dependent Variables	0.03	0.05	0.09	0.10	0.07	0.08

Notes: The table presents estimates of a model of training exposure during the first four years after entering the labor market for self or for industry or occupation average on a quadratic function of AFQT for the sample of workers with less than 16 years of initial education. Columns 1 and 2 presents estimates for the fraction of years in which the individual received corporate sponsored training and either corporate sponsored training or participated in an appreticseship out of the years spent in the labor market, columns 3 and 4 present estimates for the average fraction of worker-years during the first four years of work in which training is received for the industry that this individual initially chose where the worker themselves is excluded from the calculation, and columns 5 and 6 present estimates for an equivalent fraction calculated for initial occupation. In addition to the variables listed, the model includes controls for whether the worker is black, for the census region of residence, for whether the residence is in an urban area, whether the worker is in a part time job, year fixed effects, and linear time trend interactions with AFQT, black and initial education level. Robust standard errors are presented.

Appendix

The Returns to Ability and Experience in High School Labor Markets: Revisiting Evidence on Employer Learning and Statistical Discrimination

Workers with Four Years of College

Following Table 3, we also divide the ABH based subsample for workers with four years of college or more into subsamples with similar number of years of potential experience: 1-4, 5-8, 9-12, 13-16; again reducing noise and measurement error by collapsing the data to the worker level in order to measure average wages at different levels of potential experience. The average wage is then regressed upon the controls for AFQT, square of AFQT, as well as the standard controls in the ABH model averaged over all worker observations in a subsample. The estimates are shown in Appendix Table 1. Panel 1 shows estimates without the square of AFQT. The return to AFQT rises with potential experience, but the return to year of education also rises with potential experience inconsistent with learning. In panel 2, we add the square of AFQT, but those estimates are always insignificant and the basic pattern of results from panel 1 is unchanged.

Sibling Wage

A&P examine an alternative measure of ability, sibling wage, and find similar relationships with the return to sibling wage rising with potential experience and the return to education falling with potential experience after controlling for sibling wage. We also estimate models including controls for sibling wage. Our models follow the models in Table 3 where we estimate a pooled sample with common year trend interactions for the A&P sample and model and separate models for each subsample for the ABH sample and model. Given our non-monotonic relationship between wages and AFQT at low levels of potential experience, we measure sibling wage using their average wages between 13 and 16 years of experience adding information from later waves of the NLSY in order to observe those wages.

Appendix Table 2 presents results with panels 1 and 3 presenting estimates that replace AFQT with sibling wage for the A&P and ABH samples, respectively, and panels 2 and 4 presenting estimates for models with both sibling wage and the quadratic controls for AFQT. We do not present models including the square of sibling wage because estimates on the square are always insignificant and also lead to very noisy estimates on sibling wage effects in general. However, as in A&P, sibling wage is a significant predictor of worker wages and increases in importance as we move from the 1-4 years sample to the 5-9 years and is then relatively stable thereafter, except for the very small A&P sample with observable sibling wage and 13-16 years of experience. More importantly, the negative coefficient estimate on the square of AFQT is relatively robust to the inclusion of sibling wage at low levels of potential experience. Further, the effect of sibling wage is virtually unaffected by the inclusion of AFQT as a control suggesting that sibling wage is providing a measure of non-cognitive ability that is relatively orthogonal to the contributions of AFQT to wage. We do not observe any evidence of declining returns to education with potential experience in the models with just sibling wage, and even in the models with AFQT we only observe a decline between 8-12 and 13-16 years of potential experience.

Separate Models by Race

Next, following Pinkston (2006), Appendix Table 3 presents estimates based on subsamples split by race. Panels 1 and 2 present the estimates for whites for the A&P and ABH samples, and Panels 3 and 4 present the estimates for the black subsamples. The non-linear relationship between wages and AFQT appears quite robust within the white sample of workers with the initial non-linear relationship becoming more monotonic as the estimate of the linear term in AFQT increases with potential experience. The estimates on the non-linear term for 1-4 years of potential experience are smaller and insignificant in the black sample, which may be consistent with Pinkston's (2006) finding of greater statistical discrimination on education for black workers. We also observe some instances of larger declines in the estimates on years of education with potential experience for black workers, but those estimates are also bouncing around a lot with the smaller samples.

Alternative Models of Return to Education

Some economists have informally raised concerns about the years of education sample restrictions in ABH, namely restricting the sample to those with exactly 12 or 16 years of education. If one is willing to condition on years of education as a right hand side variable, then in principle one should be willing to condition the sample on years of education as well. So, perhaps some of the concern with restricting the sample based on years of education arises because employers may be using completion of specific education thresholds, such as completing four years of college, as a signal and the effect of these thresholds on wages is lost when the sample is restricted. So, we estimate a model with the full ABH sample including controls for years of education, completion of at least 12 years of education and completion of at least 16 years of education plus the standard controls in the ABH model. Then, to allow for the non-linear relationship for individuals not completing four years of college, we interact both AFQT and the square of AFQT with dummy variables for completing less than 16 years of education and for completing 16 years or more.

These estimates are shown in Appendix Table 4. The non-linear relationship between wages and AFQT persists for the less than 16 years of education subsample, and for the 16 years or greater subsample wages increase in an approximately linear fashion with AFQT. The estimates for completing 12 years of education or more are near zero, but the estimates for completing 16 years of education are sizable, typically implying wages over 10% higher. The independent returns to years of education are also positive at between 4 and 5 percent higher wages per year of education. The return to 16 years of education or more is very stable until the last subsample of 13-16 years of potential experience where the return declines substantially. However, the coefficient estimate on the years of education variable, which correlates with the 16 years or more variable, increases for that sample. As a result, the overall return to four years of college education relative to an individual with exactly 12 years of education is again relatively stable at 0.28 for 1-4 years of potential experience as compared to 0.27 for 13-16 years. Therefore, these estimates are not consistent with education being used as a signal for ability, and more consistent with Fang's (2006) finding that most of the college wage premium is explained by productivity gains from college.

We also explicitly allow for non-linear returns to years of education in our sample of workers without four years of college by including the square of years of education as a control. These results are shown in Appendix Table 5. The coefficient estimate on the square of years of education is always insignificant, and the non-linear relationship between early wages and AFQT is robust.

Alternative Samples

Following Table 4, Appendix Table 6 presents estimates for the NLSY 1979 sample using all waves and our preferred model specification for the subsample of workers with four years of college or more. As in Table 4, we control for initial education and potential experience depends directly or indirectly on initial education, not current education. Panel 1 presents estimates using the cubic year trend interactions where the estimates are pooled so that the year estimates are common across subsamples, and panel 2 presents estimates without the year trend interactions. We find no evidence of any non-linear returns to AFQT in this subsample. The return to AFQT does rise rapidly with potential experience, but we do not observe any corresponding decline in the return to years of education.

In Table 5, we presented estimates based on the NLSY 1997 sample. In Appendix Table 7, we present estimates from the NLSY 1997 sample using a model specification that are closer to A&P and ABH controlling for actual years of education and basing potential experience on actual years including following ABH by not incrementing potential experience when the worker leaves the labor market to return to college. The models include for ABH controls in columns 1 through 3, and add the cubic year trend interactions for columns 4 through 6. Similar to Tables 1 and 2, Panel 1 presents the basic model with potential experience interactions, panel 2 adds a control for the square of AFQT and panel 3 adds the interaction of potential experience with the square of AFQT. The potential experience interactive model in panel 1 is simply not consistent with statistical discrimination and learning in the NLSY 1997 sample. The return to AFQT only increases with potential experience for the less than 16 years of education sample, and for that sample the return to years of education does not fall. In the full sample, the potential experience interaction estimates are all near zero except for the interaction with AFQT in the model with cubic year trends and in that model return to AFQT appears to fall with potential experience. However, in panel 2, we again observe a strong negative coefficient on the square of AFQT for the less than four years of college sample. Again, the non-linear relationship between AFQT and wages is very robust.

In Appendix Table 8, we present results comparable to the NSLY 1997 estimates for the less than four years of college sample from Table 5 except that we exclude the cubic year trends, and so estimate individual models for each subsample. The results are very similar to table 5 with a non-linear relationship between AFQT and wages that weakens with potential experience, and a relationship between years of education and wages that strengthens with potential experience.

Mechanisms

The second potential mechanism considered in our paper is based on the premise that if workers expect to go back to college, they may place a lower priority on pre-college job search and work effort in those pre-college jobs. Therefore, we split the sample for the wage regressions for 1 to 4 years of potential experience based on the self-reported expectation of being in college five years after the first wave of the NLSY 79. We use the same sample of workers without four years of college and the same model controls that were used in Table 4 including using initial education except that we only include linear year trend interactions because the sample over 1 to 4 years of potential experience provides much less coverage across the sample of NLSY survey years. In fact, this model is identical to the model for Table 4 column 1 except that observations are dropped when the worker did not respond to the future college expectation question. The subsample estimates are pooled so that they have common year fixed effect and trend interaction estimates, and all other variables are interacted with a subsample dummy variable similar to Tables 3, 4 and 5.

Appendix Table 9 Panels 1 and 2 present these estimates for the full and white only samples. Column 1 contains the pooled estimates dropping observations where the question on expectation of being in school was not answered, and columns 2 and 3 contain the expectation subsample estimates. The non-linear relationship weakens when we drop individuals who did not answer the expectation question, and looking at columns 2 and 3 while the estimates are noisy any difference between the subsample estimates imply that the effects are larger in the subsample that did not expect to be in school. Appendix Figure 1 plots these estimates, and the results suggest that there is little difference in the wage-AFQT relationship between the two subsamples. Therefore, the results are inconsistent with the proposed mechanism because presumably high AFQT students who did not plan on immediately going back to college would likely place similar emphasis on finding and keeping a well-paying job as low AFQT students.

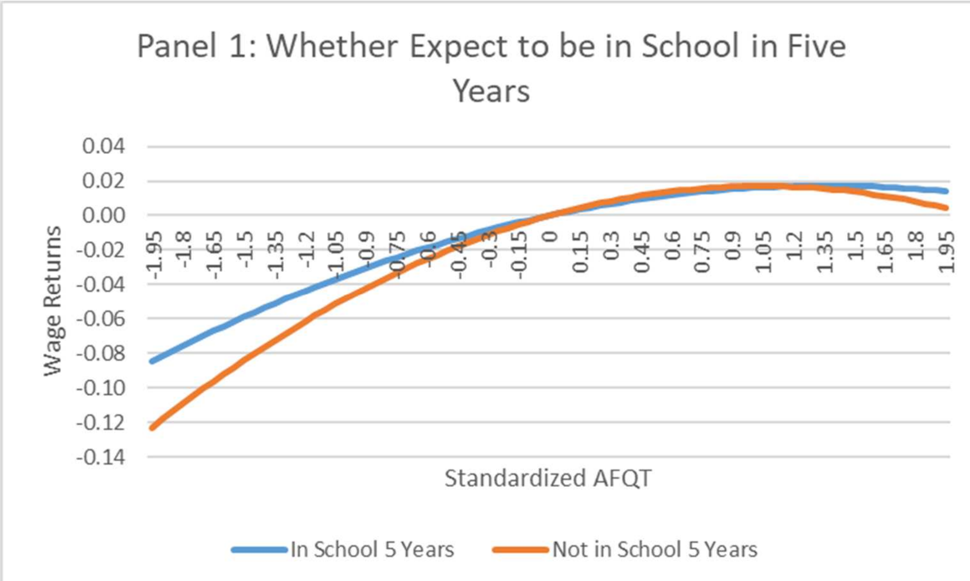
The final potential mechanism is selection into the sample of workers with less than 16 years of college. Perhaps, the non-linear relationship arises because high AFQT individuals who do not complete four years of college are negatively selected reducing their wages, and the highest AFQT workers are most selected and so have the lowest wages. To test for this, we estimate a model for having initial education of at least four years of college in the entire NLSY sample that forms the basis of Table 4. As before, we use the same model controls as used in Table 4 except years of education is omitted and the year fixed effects and trends are replaced by fixed effects associated with the age of the individual at wave 1 since both years of education and year entering the labor market are endogenous to whether the individual has an initial education of at least four years of college. We then use the model to predict the likelihood of having four years of college when entering the labor market, and split our sample of individuals without four years of college into terciles based on likelihood of college completion.

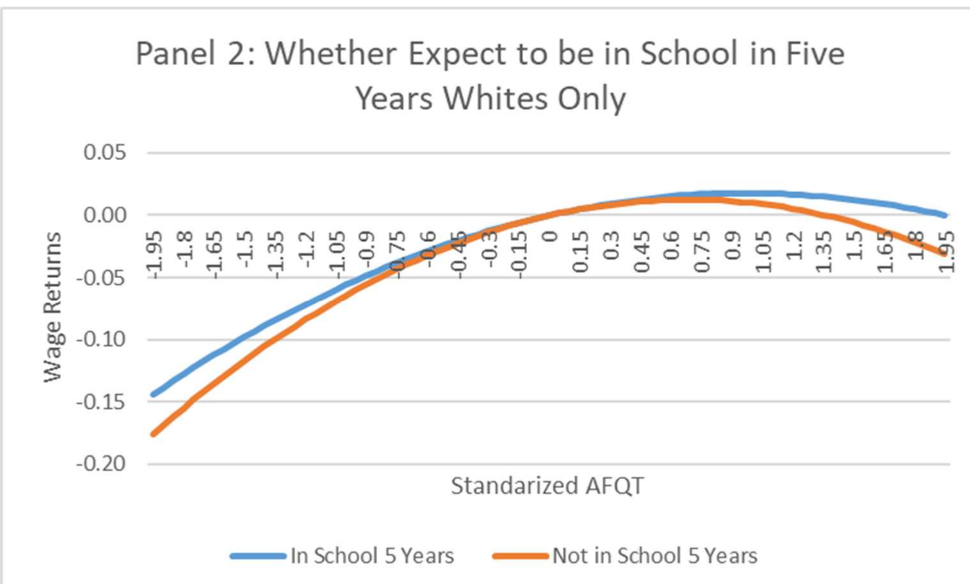
Appendix Table 10 presents estimates for both the four years of college model and for the Table 4 column 1 style early wage models for each tercile subsamples. As above, the wage models include linear rather than cubic year trend interactions and are based on pooling subsamples for a single regression with tercile dummy interactions and common year trends. As expected, column 1 shows that the likelihood of four years of college as part of initial education rises quickly with AFQT, and in fact is non-linear with the largest increases in likelihood arising for the highest levels of AFQT. The row titled "Fraction w/ out 4 years" shows the fraction of the sample in each tercile with less than four years of college, and selection of the sample is minimal for the bottom two terciles with 98 and 94 percent of the sample not having four years of college in panel 1. We observe significantly more severe selection in the top tercile with only 57 percent of workers not having a four year degree, consistent with the non-linear effect of AFQT on initially completing four years of college.

However, the estimates in columns 2 through 4 are not consistent with selection being a driving force behind the non-linear relationship between AFQT and wages. The largest coefficient on the square of AFQT is for the bottom quartile where there is virtually no selection. Appendix Figure 2 plots the relationship between AFQT and predicted wage for each subsample. One can see from the Figure that the negative relationship between AFQT and predicted wages is primarily concentrated in the bottom tercile. Further, the plotted relationships for the middle and top terciles are very similar, even though the top tercile is significantly more selected.

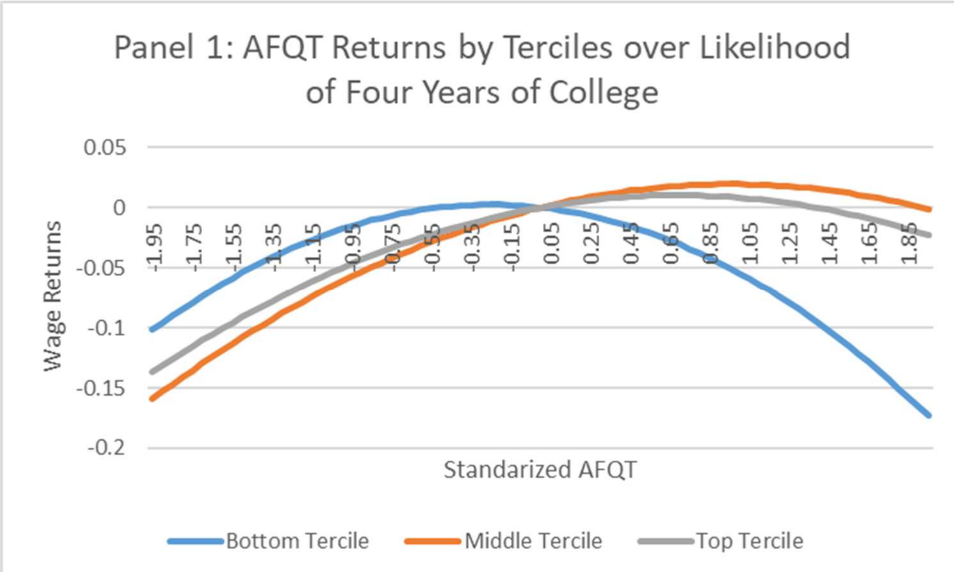
The results in Appendix Tables 9 and 10 are both robust to the omission of the year trend interactions and estimating separate early models for each subsample.

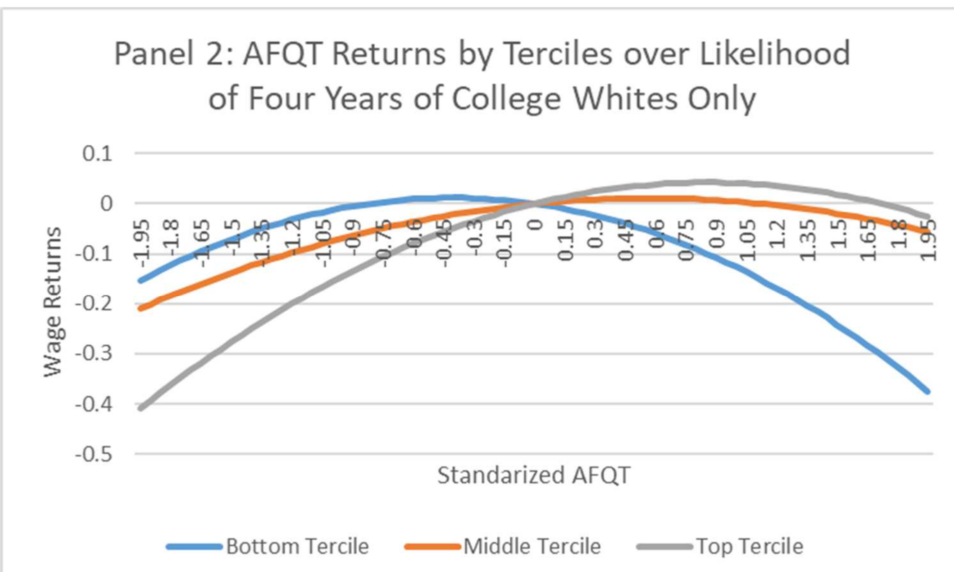
Appendix Figure 1. AFQT and Average Wages by School Expectations





Appendix Figure 2. By Likelihood of Completing Four Years of College





Appendix Table 1 AFQT Wage Returns for at least Four Years of College Sample				
Sample: Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: ABH Model				
AFQT	0.152***	0.179***	0.188***	0.255***
	(0.0297)	(0.0317)	(0.0324)	(0.0382)
Years of Education	0.0156	0.0381**	0.0372**	0.0414**
	(0.0158)	(0.0170)	(0.0176)	(0.0205)
Observations	675	708	658	569
R-Squared	0.181	0.164	0.212	0.205
Mean of Wages	11.60	14.70	17.32	20.08
Panel 2: Model with Square of AFQT				
AFQT	0.103**	0.165***	0.172***	0.211***
	(0.0518)	(0.0457)	(0.0429)	(0.0571)
AFQT^2	0.0328	0.00968	0.0111	0.0311
	(0.0282)	(0.0273)	(0.0268)	(0.0320)
Years of Education	0.0152	0.0379**	0.0370**	0.0406**
	(0.0159)	(0.0170)	(0.0176)	(0.0205)
Observations	675	708	658	569
R-Squared	0.183	0.164	0.212	0.206
Turning Point	-1.57	-8.52	-7.75	-3.39
Mean of Wages	11.60	14.70	17.32	20.08

Notes: The ABH sample of workers in each subsample is restricted to workers with 16 or more years of education. All potential experience subsamples have one observation per worker using average wages when in the labor market as the dependent variable and using the average of time varying control variables over the same waves. Panel 1 presents results for just the ABH controls, and Panel 2 presents results after including the square of AFQT. Column 1 presents the model for average wages based on observations between 1 and 4 years potential experience. Columns 2 through 4 present comparable estimates for 5-8 years, 9-12 years and 13-16 years, respectively. Seperate models are estimated for each subsample, and robust standard errors are reported.

Appendix Table 2 Controlling for Sibling Wages

Average over Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: Sibling Wage for A&P				
Sibling Wage 13-16 Yrs	0.0971***	0.152***	0.142***	0.0521
	(0.0226)	(0.0281)	(0.0350)	(0.0330)
Years Education	0.0585***	0.0592***	0.0666***	0.0610**
	(0.00916)	(0.0121)	(0.0162)	(0.0246)
Observations	1,010	1,091	949	375
R-Squared	0.379			
Panel 2: Sibling Wage and AFQT				
Sibling Wage 13-16 Yrs	0.0964***	0.145***	0.129***	0.0467
	(0.0228)	(0.0282)	(0.0346)	(0.0336)
AFQT	-0.00615	0.0274	0.0441	0.0642
	(0.0179)	(0.0246)	(0.0338)	(0.0432)
AFQT^2	-0.0192*	-0.0211	-0.0325**	-0.0240
	(0.0107)	(0.0131)	(0.0147)	(0.0265)
Years Education	0.0585***	0.0552***	0.0619***	0.0538*
	(0.00979)	(0.0144)	(0.0212)	(0.0324)
Observations	1,010	1,091	949	375
R-Squared	0.392			
Panel 3: Sibling Wage w/ Education <16 ABH Model				
Sibling Wage 13-16 Yrs	0.0610***	0.113***	0.121***	0.119***
	(0.0180)	(0.0225)	(0.0235)	(0.0258)
Years Education	0.0605***	0.0667***	0.0772***	0.0761***
	(0.0114)	(0.0116)	(0.0105)	(0.0119)
Observations	947	944	898	801
R-Squared	0.182	0.197	0.284	0.234
Panel 4: Sibling Wage and AFQT w/ Education <16 ABH Model				
Sibling Wage 13-16 Yrs	0.0572***	0.105***	0.113***	0.113***
	(0.0180)	(0.0221)	(0.0234)	(0.0252)
AFQT	0.0249	0.0377**	0.0796***	0.104***
	(0.0167)	(0.0175)	(0.0198)	(0.0198)
AFQT^2	-0.0192	-0.0443***	-0.0284**	-0.0195
	(0.0142)	(0.0134)	(0.0133)	(0.0134)
Years Education	0.0522***	0.0506***	0.0517***	0.0435***
	(0.0123)	(0.0125)	(0.0119)	(0.0134)
Observations	947	944	898	801
R-Squared	0.189	0.217	0.312	0.267

Notes: Panel 1 replaces AFQT in the A&P model with average sibling wage from when sibling had 13-16 years of potential experience using all waves of the NLSY. Panel 2 includes both sibling wage, AFQT and AFQT squared. Panel 3 replaces AFQT in the ABH model with the same sibling wage using the less than 16 years of education sample, and Panel 4 includes sibling wage, AFQT and AFQT squared. This table follows the same structure as Table 3. The columns are for worker average wages over different years of potential experience. In panels 1 and 2, the AFQT estimate is based on year trends initialized for the subsample initial potential experience and education is based on year trends initialized for one year of potential experience, and standard errors are clustered at the worker level. Panels 3 and 4 present estimates from seperate regressions for each column, and standard errors are robust.

Appendix Table 3 Wage Models for Blacks and Whites Seperately

Average over Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: White Workers A&P				
AFQT	0.00860	0.0456***	0.0693***	0.0832**
	(0.0130)	(0.0151)	(0.0202)	(0.0324)
AFQT^2	-0.0251***	-0.0302***	-0.0429***	-0.0422
	(0.00936)	(0.0106)	(0.0133)	(0.0259)
Years Education	0.0664***	0.0613***	0.0607***	0.0470**
	(0.00710)	(0.00955)	(0.0146)	(0.0236)
Observations	1,668	1,858	1,438	517
R-Squared	0.350			
Panel 2: White Workers w/ Education <16 ABH Model				
AFQT	0.0400***	0.0686***	0.109***	0.118***
	(0.0125)	(0.0123)	(0.0142)	(0.0165)
AFQT^2	-0.0366***	-0.0290**	-0.0204	-0.0199
	(0.0107)	(0.0114)	(0.0127)	(0.0145)
Years Education	0.0547***	0.0502***	0.0464***	0.0509***
	(0.00758)	(0.00875)	(0.00908)	(0.0123)
Observations	1,668	1,748	1,421	1,099
R-Squared	0.181	0.152	0.197	0.179
Panel 3: Black Workers A&P				
AFQT	-0.0200	0.0624	0.0920**	0.0973
	(0.0329)	(0.0397)	(0.0454)	(0.0755)
AFQT^2	-0.00680	-0.0151	-0.0287	-0.00921
	(0.0161)	(0.0173)	(0.0206)	(0.0334)
Years Education	0.0548***	0.0564***	0.0274	0.0180
	(0.0125)	(0.0151)	(0.0205)	(0.0296)
Observations	639	786	697	322
R-Squared	0.360			
Panel 4: Black Workers w/ Education <16 ABH Model				
AFQT	0.0210	0.0702***	0.0852***	0.130***
	(0.0245)	(0.0271)	(0.0304)	(0.0349)
AFQT^2	-0.00616	-0.0234	-0.0208	0.00329
	(0.0162)	(0.0178)	(0.0176)	(0.0200)
Years Education	0.0485***	0.0458***	0.0391***	0.0506***
	(0.0130)	(0.0122)	(0.0124)	(0.0140)
Observations	738	801	779	703
R-Squared	0.141	0.196	0.208	0.182

Note: This table replicates the results in Table 3 for white and black subsamples. Panels 1 and 2 present the results for the white subsample shown in Panels 1 and 2 of Table 3, and Panels 3 and 4 present equivalent results for the black subsample. The columns are for worker average wages over different years of potential experience. In panels 1 and 3, the AFQT estimate is based on year trends initialized for the subsample initial potential experience and education is based on year trends initialized for one year of potential experience, and standard errors are clustered at the worker level. Panels 2 and 4 present estimates from seperate regressions for each column, and standard errors are robust.

Appendix Table 4 Educational Attainment and Wages

Average over Years of Potential Experience	1-4	5-8	9-12	13-16
AFQT*Less than 16 Years	0.0427***	0.0765***	0.111***	0.131***
	(0.00988)	(0.0104)	(0.0123)	(0.0139)
AFQT^2*Less than 16 Years	-0.0191**	-0.0248***	-0.0153*	-0.00988
	(0.00782)	(0.00830)	(0.00900)	(0.00974)
AFQT*16 or more Years	0.0577	0.0919**	0.100**	0.137**
	(0.0362)	(0.0390)	(0.0467)	(0.0552)
AFQT^2*16 or more Years	0.0270	0.0300	0.0377	0.0418
	(0.0237)	(0.0261)	(0.0310)	(0.0327)
Completed 12 or more Years	0.0106	-0.00133	0.0102	-0.0402
	(0.0261)	(0.0282)	(0.0301)	(0.0383)
Completed 16 or more Years	0.112***	0.125***	0.116**	0.0643
	(0.0408)	(0.0439)	(0.0478)	(0.0576)
Years Education	0.0428***	0.0435***	0.0392***	0.0508***
	(0.00805)	(0.00847)	(0.00872)	(0.0105)
Observations	3,054	3,222	2,842	2,366
R-Squared	0.329	0.352	0.384	0.397
Turning Point for < 16 Years	1.12	1.54	3.63	6.63
Mean of Wages	8.20	9.89	11.37	12.76

Notes: The subsamples use the entire ABH sample regardless of years of education. Each subsample has one observation per worker using average wages when in the labor market as the dependent variable and using the average of time varying control variables over the same waves. The model includes all controls in the ABH model plus years of education, whether years of education is 12 or higher and whether years of education is 16 or higher. The model also omits the AFQT and AFQT squared variables, replacing them with the interaction of those variables with dummies for years of education less than 16 and for years of education 16 or more. Seperate regressions are run for each subsample, and robust standard errors are reported.

Appendix Table 5 Determinants of Wages controls for Quadratic in Years Education

Average over Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: A&P Model and Sample w/ Cubic HC Trends only				
AFQT	-0.00191	0.0411***	0.0679***	0.0760***
	(0.0115)	(0.0136)	(0.0199)	(0.0282)
AFQT^2	-0.0162**	-0.0270***	-0.0346***	-0.0268
	(0.00691)	(0.00764)	(0.00953)	(0.0170)
Years Education	-0.0513	0.0118	0.0142	-0.0241
	(0.0472)	(0.0415)	(0.0451)	(0.0822)
Years Education^2	0.00449**	0.00232	0.00217	0.00377
	(0.00185)	(0.00171)	(0.00192)	(0.00362)
Observations	2,307	2,644	2,135	839
R-Squared	0.357	0.357	0.357	0.357
Mean of Wages	6.86	8.25	8.81	8.29
Panel 2: ABH Model and Sample w/ Education <16				
AFQT	0.0301***	0.0681***	0.103***	0.118***
	(0.0101)	(0.0105)	(0.0125)	(0.0140)
AFQT^2	-0.0205***	-0.0251***	-0.0181**	-0.0126
	(0.00772)	(0.00825)	(0.00900)	(0.00967)
Years Education	0.0310	0.00577	-0.0403	-0.196***
	(0.0572)	(0.0592)	(0.0594)	(0.0760)
Years Education^2	0.000943	0.00177	0.00353	0.0102***
	(0.00240)	(0.00252)	(0.00253)	(0.00320)
Observations	2,406	2,549	2,200	1,802
R-Squared	0.171	0.179	0.246	0.245
Mean of Wages	7.26	8.53	9.60	10.41

Notes: Replicates Table 3 adding a control for the square of the number of years of education. The columns are for worker average wages over different years of potential experience. In panels 1 and 3, the AFQT estimate is based on year trends initialized for the subsample initial potential experience and education is based on year trends initialized for one year of potential experience, and standard errors are clustered at the worker level. Panels 2 and 4 present estimates from seperate regressions for each column, and standard errors are robust.

Appendix Table 6 Different Levels of Potential Experience 16 or More Years of Education								
Sample: Years of Potential Experience	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32
				Panel 1: Trend Interactions				
AFQT	0.101**	0.147***	0.244***	0.303***	0.232***	0.306***	0.314***	0.266**
	(0.0410)	(0.0470)	(0.0654)	(0.0735)	(0.0814)	(0.0833)	(0.0885)	(0.115)
AFQT^2	0.0311	0.0345	0.0174	0.0507	0.0174	0.00989	0.0373	0.0880
	(0.0248)	(0.0283)	(0.0389)	(0.0375)	(0.0431)	(0.0463)	(0.0460)	(0.0670)
Initial Years Education	0.0338**	0.0807***	0.110***	0.0450	0.112**	0.0889*	0.111*	0.124*
	(0.0160)	(0.0244)	(0.0347)	(0.0443)	(0.0492)	(0.0509)	(0.0625)	(0.0736)
Observations	696	668	616	522	479	467	450	327
R-Squared				0.333				
Turning Point	-1.62	-2.13	-7.01	-2.99	-6.67	-15.47	-4.21	-1.51
Mean of Wages	11.57	15.27	18.65	22.29	25.03	26.5	26.66	27.1
				Panel 2: Without Trend Interactions				
AFQT	0.104***	0.121***	0.186***	0.286***	0.181**	0.272***	0.294***	0.253**
	(0.0388)	(0.0451)	(0.0579)	(0.0701)	(0.0766)	(0.0815)	(0.0812)	(0.113)
AFQT^2	0.0271	0.0440	0.0267	0.0310	0.0149	-0.00294	0.0189	0.0829
	(0.0238)	(0.0279)	(0.0352)	(0.0401)	(0.0448)	(0.0484)	(0.0495)	(0.0690)
Initial Years Education	0.0288**	0.0706***	0.0911***	0.0267	0.113***	0.0913***	0.121***	0.142***
	(0.0144)	(0.0209)	(0.0265)	(0.0314)	(0.0304)	(0.0288)	(0.0309)	(0.0395)
Observations	696	668	616	522	479	467	450	327
R-Squared	0.176	0.168	0.247	0.174	0.132	0.148	0.218	0.195
Turning Point	-1.92	-1.38	-3.48	-4.61	-6.07	46.26	-7.78	-1.53
Mean of Wages	11.57	15.27	18.65	22.29	25.03	26.5	26.66	27.1

Notes: Presents estimates for worker average wage when in the labor market over the years of potential experience identified in the column headings. Wage information from all waves of the NLSY are included. The sample is restricted to workers with 16 years of education or more in their first year of potential experience or when first observed if in the labor market in 1979. All models control for the initial years of education rather than actual education when surveyed. The columns are for worker average wages over different years of potential experience. All models include the controls from the ABH model, and the model in panel 1 includes the interaction of the year cubic with AFQT, years of education and race. In panel 1, the AFQT estimate is based on year trends initialized for the subsample initial potential experience, the education estimate is based on year trends initialized for one year of potential experience, and standard errors are clustered at the worker level. Panel 2 presents estimates from seperate regressions for each column, and standard errors are robust.

Appendix Table 7 NSLY 1997 Replication

Model	No Year Trends			Cubic Year Trends		
Sample: Years of Educat	Less than 16	16 or More	Full Sample	Less than 16	16 or More	Full Sample
Panel 1: Statistical Discrimination Model						
AFQT	-0.0120	0.129***	0.0228**	-0.0172*	0.230	0.00954
	(0.00947)	(0.0271)	(0.0108)	(0.0102)	(0.185)	(0.00896)
AFQT*Pot Exper/10	0.0358***	-0.0562**	7.70e-04	0.0757**	-0.0776***	-0.0662***
	(0.0127)	(0.0256)	(0.0139)	(0.0382)	(0.0218)	(0.0202)
Years Education	0.0518***	0.0641***	0.0865***	0.0544***	0.0776***	0.0668***
	(0.00876)	(0.0159)	(0.00583)	(0.00866)	(0.0194)	(0.00695)
Years Ed*Pot Exper/10	0.0163	-0.00775	-0.00284	0.0170	-0.0152**	0.00417
	(0.0105)	(0.00644)	(0.00233)	(0.0172)	(0.00645)	(0.00395)
Observations	18,261	4,960	23,221	18,261	4,960	23,221
R-Squared	0.145	0.150	0.218	0.146	0.153	0.222
Mean of Wages	10.70	16.61	11.96	10.70	16.61	11.96
Panel 2: Non-linear Returns to AFQT						
AFQT	-0.0251**	0.0972***	0.0219**	-0.0296***	0.131	0.00176
	(0.0103)	(0.0357)	(0.0110)	(0.0107)	(0.186)	(0.00989)
AFQT^2	-0.0282***	0.0338	-0.00432	-0.0297***	0.0395	-0.0145**
	(0.00632)	(0.0241)	(0.00601)	(0.00665)	(0.0243)	(0.00600)
AFQT*Pot Exper/10	0.0241*	-0.0578**	-0.00143	0.0171	-0.0845***	-0.0858***
	(0.0129)	(0.0285)	(0.0139)	(0.0403)	(0.0242)	(0.0204)
Years Education	0.0528***	0.0634***	0.0868***	0.0545***	0.0754***	0.0676***
	(0.00877)	(0.0158)	(0.00583)	(0.00868)	(0.0194)	(0.00693)
Years Ed*Pot Exper/10	0.0156	-0.00776	-0.00292	0.0233	-0.0150**	0.00423
	(0.0105)	(0.00644)	(0.00229)	(0.0173)	(0.00651)	(0.00395)
Observations	18,261	4,960	23,221	18,261	4,960	23,221
R-Squared	0.149	0.151	0.218	0.150	0.155	0.222
Panel 3: Non-linear Returns Evolving Over Time						
AFQT	-0.0218**	0.0917***	0.0254**	-0.0260**	0.139	0.00533
	(0.0111)	(0.0342)	(0.0108)	(0.0114)	(0.189)	(0.0102)
AFQT^2	-0.0234***	0.0268	0.00440	-0.0247***	0.0370	-0.00891
	(0.00766)	(0.0233)	(0.00826)	(0.00777)	(0.0236)	(0.00702)
AFQT*Pot Exper/10	0.0183	-0.0533**	-0.00951	0.0109	-0.0811***	-0.0906***
	(0.0168)	(0.0227)	(0.0139)	(0.0424)	(0.0248)	(0.0220)
AFQT^2*Pot Exper/10	-0.00728	0.0217*	-0.0140	-0.00767	0.00646	-0.00868
	(0.0109)	(0.0122)	(0.00942)	(0.0109)	(0.0100)	(0.00805)
Years Education	0.0527***	0.0637***	0.0865***	0.0544***	0.0769***	0.0671***
	(0.00878)	(0.0158)	(0.00581)	(0.00869)	(0.0193)	(0.00690)
Years Ed*Pot Exper/10	0.0158	-0.00845	-0.00243	0.0237	-0.0154**	0.00472
	(0.0105)	(0.00659)	(0.00219)	(0.0173)	(0.00645)	(0.00404)
Observations	18,261	4,960	23,221	18,261	4,960	23,221
R-Squared	0.149	0.152	0.218	0.150	0.155	0.222

Notes: Panel 1 replicates the interactive models in Tables 1 and 2 based on A&P and ABH using data from all waves of the NLSY 1997. The additional controls are based on the combined set of controls selected in this paper for the extended NSLY 79 sample created for Table 3 except that education is allowed to time vary and potential experience is adjusted to account for workers returning to school similar to A&P and ABH. Panel 1 interacts AFQT, years of education and race with potential experience. Panel 2 adds a control for the square of AFQT, and Panel 3 adds controls for both the square of AFQT and its interaction with potential experience. Columns 1 and 4 use a subsample of workers that have less than 16 years of education, columns 2 and 5 present estimates for all workers with 16 years of education or more, and Columns 3 and 6 present estimates for the full sample. Columns 1 through 3 do not include controls for the interaction of year trends with AFQT, years of education and race. Columns 4 through 6 add those interactions. Year trends are initialized to zero at the year 2000, the year in which the most individuals in the sample had their first year of potential experience. Standard errors are clustered at the individual worker level.

Appendix Table 8 Determinants of Average Wages w/ no Trend Interactions

Sample: Years of Potential Experience	1-4	5-8	9-12	13-16
Panel 1: Less Than 16 Years of Education				
AFQT	-0.00634	0.00552	0.0297*	0.0363*
	(0.0101)	(0.0130)	(0.0156)	(0.0201)
AFQT^2	-0.0228***	-0.0154	-0.0260**	-0.0210
	(0.00676)	(0.00953)	(0.0105)	(0.0138)
Initial Years Education	0.0229***	0.0265***	0.0343***	0.0526***
	(0.00720)	(0.00894)	(0.0109)	(0.0131)
Observations	2,001	1,800	1,695	1,320
R-Squared	0.144	0.122	0.149	0.133
Turning Point	-0.14	0.18	0.57	0.86
Mean of Wages	8.97	11.30	12.67	13.89
Panel 2: Less Than 16 Years of Education White Workers Only				
AFQT	-0.0119	0.00595	0.0315*	0.0349
	(0.0120)	(0.0146)	(0.0172)	(0.0229)
AFQT^2	-0.0207**	-0.0292***	-0.0275**	-0.0255
	(0.00977)	(0.0112)	(0.0129)	(0.0186)
Initial Years Education	0.0148	0.0223*	0.0419***	0.0559***
	(0.00959)	(0.0115)	(0.0132)	(0.0164)
Observations	1,325	1,179	1,112	847
R-Squared	0.135	0.132	0.144	0.127
Turning Point	-0.29	0.10	0.57	0.68
Mean of Wages	9.44	11.91	13.50	15.05

Notes: Presents estimates for worker average wage when in the labor market over the years of potential experience identified in the column headings using the NLSY 1997 following the same sample selection process used to create the extended sample of workers for Table 4. Wage information from all waves of the NLSY 1997 are included. Following Table 4, the regression uses initial education and potential experience is incremented yearly after entering the labor market whether or not the individual returns to school, but omits the year trend interactions. The sample is restricted to workers with less than 16 years of education in their first year of potential experience or when first observed if in the labor market in 1997. Panel 1 presents estimates for the full sample of white and black workers, and panel 2 presents estimates for the subsample of white workers only. Each column present estimates from seperate regressions for each column, and standard errors are robust.

Appendix Table 9 Relationship between Early Wages and AFQT by College Expectations

		College Expectations	
	Pooled sample	In School in 5 years	Not in School
Panel 1: Less Than 16 Years of Initial Education			
AFQT	0.0333***	0.0253	0.0362***
	-0.00996	-0.0162	-0.012
AFQT^2	-0.0146*	-0.00926	-0.0156*
	-0.00754	-0.0125	-0.00922
Observations	2,683	967	1,716
R-Squared	0.179	0.182	
Mean of Dep Var	6.51	6.49	6.51
Panel 2: Less Than 16 Years of Initial Education Workers White Only			
AFQT	0.0386***	0.0369*	0.0372***
	(0.0113)	(0.0200)	(0.0131)
AFQT^2	-0.0256***	-0.0190	-0.0273**
	(0.00967)	(0.0155)	(0.0120)
Observations	1,886	589	1,297
R-Squared	0.195	0.200	
Mean of Dep Var	6.53	6.52	6.54

Notes: The table presents estimates of a model of average early wages for the sample of workers with less than 16 years of initial education. Column 1 presents estimates using the entire sample, and columns 2 and 3 present estimates for subsamples based on whether the individual reported in wave 1 in 1979 that that they expected to be in college five years after the survey. Early wages are the average of wages observed for all years the worker participates in the labor market during the first four years after entering the labor market. In addition to the variables listed, the model includes controls for whether the worker is black, for the census region of residence, for whether the residence is in an urban area, whether the worker is in a part time job, year fixed effects, and linear time trend interactions with AFQT, black and initial education level. The model for columns 2 and 3 is based on the pooled sample interacting all variables except those related to year with subsample dummies. Robust standard errors are presented.

Appendix Table 10 Evidence of Selection into College Completion

	Four Year College	Average Wages Bottom Tercile	Average Wages Middle Tercile	Average Wages Top Tercile
Panel 1: Less Than 16 Years of Initial Education				
AFQT	0.154***	-0.0183	0.0404*	0.0292
	-0.0056	-0.0556	-0.0211	-0.0217
AFQT^2	0.0757***	-0.0362	-0.0098	-0.0211*
	-0.00415	-0.036	-0.0163	-0.012
Observations	4,731	895	1083	790
Fraction w/ out 4 Years		0.978	0.935	0.568
R-Squared	0.302		0.176	
Mean of Dep Var	0.155	6.45	6.52	6.55
Panel 2: Less Than 16 Years White Workers Only				
AFQT	0.154***	-0.0569	0.0394*	0.0985***
	-0.0056	-0.0591	-0.0224	-0.0237
AFQT^2	0.0757***	-0.0695*	-0.0350*	-0.0572***
	-0.00415	-0.0409	-0.0197	-0.016
Observations	4,731	551	735	658
Fraction w/ out 4 Years		0.982	0.935	0.556
R-Squared	0.302		0.195	
Mean of Dep Var	0.155	6.47	6.55	6.57

Notes: The first column presents estimates for the full sample of all workers for a dummy variables for whether the worker completed 16 or more years of education. The model includes the standard controls as of wave 1 except that year fixed effects are replaced by age in wave 1 fixed effects, the year trend interactions are dropped, and obviously education is removed from the right hand side. The next three columns present estimates of a model of early wages for the sample of workers with less than 16 years of initial education for tercile subsamples in columns 2, 3 and 4 based on the predicted likelihood of completing at least a four years of college using the model presented in column 1. Early wages are the average of wages observed for all years the worker participates in the labor market during the first four years after entering the labor market. In addition to the variables listed, the model includes controls initial years of education, for whether the worker is black, for the census region of residence, for whether the residence is in an urban area, whether the worker is in a part time job, year fixed effects, and linear time trend interactions with AFQT, black and initial education level. Robust standard errors are presented.