

The Effect of Higher Education on Careers of Workers

WooRam Park *

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Abstract

This paper documents the effects of the productivity revealing function of higher education, which is recently documented by Arcidiacono, Bayer and Hizmo (2010), on the subsequent careers of workers. Unlike the accumulation and signaling of human capital, the productivity revealing function of higher education yields simple and unambiguous predictions on the post-schooling productivity revealing activities of high school and college graduates. Given the functions of higher education, I build a model that predicts active productivity revealing activity for high school graduate workers and inactive productivity revealing activity for college graduates. In particular, the productivity revealing activity will be positively related with ability for high school workers. However, among college graduates, the activity that can be served as 'productivity revealing' will not be positively related to ability. I test these predictions using NLSY79 public data by regressing productivity revealing activity and job mobility on AFQT scores separately for high school and college graduates. Overall, the results coincide with the predictions of the model quite well, implying the importance of the function of higher education on understanding the different careers of high school and college graduates.

*Ph.D. Candidate, Department of Economics, Columbia University; 420 West 118th Street, New York, NY 10027; Contact at wp2135@columbia.edu I am very grateful for support, guidance, and many helpful comments from Miguel Urquiola. I thank Bentley MacLeod, Cristian Pop-Eleches, Eric Verhoogen and Till von Wachter for the suggestions and the participants of the Columbia University Applied Microeconomics Colloquium for their comments. All errors are my own

1 Introduction

A large body of literature documents the pecuniary return to higher education by comparing the wages of high school and college graduates (Juhn, Murphy and Pierce (1993) and Katz and Autor (1999)). However, the effects of higher education on other important aspects of individuals' careers—such as job mobility, training and sorting across jobs—have not been well documented.

Moreover, there is only a small amount of literature explaining the different career patterns among high school and college graduates as they related to the functions of higher education. Since Becker (1964) and Spence (1973), the key functions of higher education have been described as human capital accumulation and the signaling of ability. Although these two functions have clear implications for the source of the return to higher education, it is not clear how they will affect the subsequent careers of workers.¹

While taking into account the previously discussed literature, the main goal of this paper is to document the effects of a recently discovered function of higher education that yields clear predictions on the careers of workers after their graduations. To be specific, I focus on the productivity revealing function which has been recently documented by Arcidiacono, Bayer and Hizmo (2010) (ABH (2010) hereafter). ABH (2010) asserts that college graduates' wages are correlated with their own abilities while the wages of high school graduates unrelated to their individual ability in the beginning of their careers. The authors interpret their findings as evidence that supports the existence of the productivity revealing function of higher education. In addition to ABH (2010), there are several papers which also document the pooling of young high school graduates and the possible mechanisms related the phenomenon. For instance, Bishop (1994) asserts that high school graduates have difficulty promoting their high school achievements and firms have difficulty getting information on school performance. He insists that, as a result, during the first decade after leaving high school, young men do not receive rewards for developing competence in science, language arts and mathematical reasoning. Moreover, Hotchkiss (1984) and Rosenbaum (1990) find that non-cognitive traits such as maintaining low absenteeism, obeying the law, and using good study habits are also not positively related to labor market outcomes immediately after high school.

¹For instance, given the human capital accumulation function of higher education, college graduates can either have more post-schooling training than high school graduates or less training depending on the degree of complimentary between human capital obtained by schooling and human capital obtained by training. Similarly, since the traditional theory mainly focuses on the separation of college and high school graduates through different amount of schooling, it does not yield a testable prediction on how each group will engage in productivity revealing activities after they enter the job market.

These papers demonstrate that having both cognitive and non-cognitive skills—both of which are believed to be related to productivity—is not reflected in the wages of young high school graduates. Thus, at the early stages of their careers, high ability high school graduates will be ‘pooled’ with low ability high school graduates.

In contrast to high school graduates, many aspects of a college education make the abilities of young college graduates readily identifiable. For instance, unlike high schools, most colleges have a dedicated department and/or personnel which issue transcripts and certificates that are needed to verify the achievements of their graduates. More importantly, as Hoxby (1997) documents, the abilities of students are homogenous within the university but heterogeneous across the university. Given the sorting of students by the ranking or selectivity of colleges, potential employers will obtain relatively accurate information about college graduates by simply observing the names of their alma maters. As a result, there will be a difference in earning among young college graduates which will roughly coincide with the different degree of selectivity across colleges. A recent paper by Hoekstra (2009) shows that the graduates from highly selective colleges earn more than their counterparts from less selective institutions in the early stages of their careers. He asserts that the signaling effect of being ‘flagship’ college graduates could lead to an increase in earnings.² However, the sorting across high schools by ability is not as clear as with colleges since the admission to specific high schools is usually residence-based. Also, rankings among high schools are not well established or publicly acknowledged like rankings among colleges are. Thus, the employer will need further information about high school graduates to evaluate their abilities. Overall, the evidence from the literature shows that high school graduates are likely to be pooled together, whereas college graduates are separated at the beginning of their careers.

Based on the evidence of the productivity revealing function of higher education, I argue that this function of higher education yields clear and unambiguous predictions regarding worker’s subsequent productivity revealing behaviors. To be concrete, if the individual abilities of high school graduates are not directly observable, then, high ability high school graduates will not be appropriately compensated since their wages will be set based on the ability of average high school graduates. If this is the case, it can be predicted that high ability high school graduates will engage in activities that will separate themselves from the low ability high school graduates after they enter the job market. More specifically, I predict that the high ability high school graduates will be

²Other literature that examines the return from attending more selective colleges includes Loury and Garman (1995), Brewer, Eide and Ehrenberg (1999), Monks (2000) and Dale and Krueger (2002)

more likely to obtain off-the-job training, and more likely to sort themselves into performance pay jobs in which the wage is closely related to ability.

Unlike high school graduates, I do not expect high ability college graduates to engage in costly activities to separate themselves from those of low ability since the abilities of college graduates are apparent at the beginning of their careers. Thus, the probability of participating in off-the-job training and sorting into performance pay jobs would not be positively correlated on the measure of ability among college graduates at the early stages of their careers.

Moreover, I expect that the job mobility of high ability high school graduates will be higher than that of low ability counterparts as they move to better jobs and differentiate themselves from low ability workers. However, since college graduates are assigned to jobs according to their abilities from the beginning of their careers, their job mobility will not necessarily depend on ability. Thus, the job mobility of college graduate workers will be determined by the factors that are not related to ability such as a random job match between employer and employee. This mechanism provides an alternative explanation to the traditional search theory that has been applied to explain the positive return to job mobility among high school graduates in Topel and Ward (1992).

I verify these predictions with NLSY79 public data by documenting the different relationships between AFQT scores and productivity revealing activities across high school and college graduates. The different patterns of productivity revealing across high school and college graduates coincide with the prediction of the signaling model under a different degree of asymmetric information between employers and workers across two groups. The results also illustrate the role of productivity revealing activities of workers as an alternative mechanism for employer learning in explaining the wage of high school workers eventually reflecting their individual abilities.

The rest of the paper is organized into the following sections. Section 2 models individual's sorting behavior into higher education and the subsequent aspects of careers using a two stage model. Section 3 describes the testable implications of the model for job mobility and productivity revealing activities. In Section 4, an overview of NLSY79 and the sample construction are described, followed by the identification strategy and estimating equation in Section 5. Section 6 presents the main empirical results that verify the prediction of the model. Section 7 compares this paper with the employer learning model, and Section 8 concludes.

2 Model

This section illustrates a base model that can explain individuals' sorting into higher education and productivity revealing activities under imperfect information. The model is based on several assumptions about the cost of productivity revealing activities and the ability distribution of workers.

1. There is a distribution of ability of individuals $a \sim F(a)$ in a society. The employers do not have direct information about the individual abilities of workers.
2. The return from higher education is not negatively correlated with ability and the cost of schooling is not positively correlated with ability.
3. The labor market is perfectly competitive. Thus, the wage of workers equals the expected productivity of the workers
4. The cost of productivity revealing activities is not extremely high and the dispersion of ability is large enough to make productivity revealing activities profitable for some portion of top ability workers.

At the first stage, people decide whether they will sort into higher education or not. Under the standard assumed functions of higher education—signaling and human capital accumulation—and the reasonable assumptions about the costs of higher education, a certain portion of individuals from the top of the ability distribution will sort in to higher education. Specifically, there is an ability cutoff a^* where individuals with ability greater than a^* sort into higher education. Individuals who sort into higher education become college graduates and individuals who do not enter higher education remain high school graduates. For simplicity, I ignore high school dropouts and individuals who have not completed college.^{3 4}

At the beginning of the second stage, individuals finish their schooling and enter the job market. The individuals then decide whether to engage in productivity revealing activities that will further reveal their abilities. Employers know that the average ability of college graduates is higher than

³It is worth noting that the prediction and/or implication of the model will not be dependent on the source of the return to education. That is, motivation for education does not matter as long as high ability individuals sort into higher education. The productivity revealing function of higher education will be applied to college graduates *regardless* of the workers' motivation for entering higher education.

⁴Including workers with only some college education will only make the model more complicated without gaining meaningful prediction or implication.

the average ability of high school graduates. Moreover, given the productivity revealing function of higher education, college graduates will receive wages according to their individual abilities. However, in regards to wages, high school graduates will be pooled at the beginning of their careers, since employers cannot verify the individual abilities of high school graduates. Thus, the wages of college workers whose abilities are a will be $a + H$, where H is human capital accumulation from college education and the wages of high school graduates will be $E(a|a < a^*)$ regardless of the value of individual abilities a .⁵

Thus, given these initial wages of high school graduates, some portion of high ability high school graduates will engage in productivity revealing activities to separate themselves from low ability high school graduates and to ultimately get paid for their individual abilities. However, high ability college graduates will not engage in costly productivity revealing activities since they are already separated from their low ability counterparts. I exploit this predicted difference in productivity revealing activities across high school and college graduates to identify the effects of higher education on the subsequent careers of individuals.

3 Testable Implications

In this section, my prediction on productivity revealing activities is provided in detail. In particular, I describe off-the-job training and sorting into performance pay jobs as productivity revealing activities. I also predict different relationships between ability and job mobility across high school and college graduates under differing degrees of imperfect information across the two groups.

3.1 Off-the-Job Training

The previous literature on training mainly focuses on the human-capital-mediated effect of training on wage increases or job mobility (Lynch (1991, 1992) and Parent (1999)). In contrast, here I view training mainly as a mean to reveal the productivity of workers. In particular, off-the-job training (OFT) is similar to schooling in the sense that the worker pays the cost of the training, and the contents of the training are not firm-specific. Given the similarities between off-the-job training and schooling, off-the-job training can be used as a signaling device. Thus, as traditional signaling theory (Spence (1973)) would predict, the high ability workers will be more likely to obtain OFT than their low ability counterparts if they are not differentiated from their low ability counterparts.

⁵The prediction of the model does not depend on the magnitude of human capital component, H .

Thus, for the high school graduates whose abilities are not revealed at the beginning of their careers, the probability of getting off-the-job training will be positively related with their AFQT scores, as high ability high school graduates use OFT as a productivity revealing device. However, for college graduates whose individual abilities are already apparent, the probability of obtaining OFT will not necessarily depend positively on measured ability. Moreover, since the return from being separated from low ability workers decrease with time, the probability of getting OFT will decrease faster with experience for high ability high school graduates compared to their low ability counterparts. In other words, the experience gradient will be steeper for the high ability high school graduates whose motivation for taking OFT depends on both signaling (productivity revealing) and human capital accumulation. However, I do not expect a difference in the experience gradient across ability among college graduates since the high ability college graduates do not have additional incentives to take OFT in the early stage of their careers.

3.2 Performance Pay

A recent paper by Lemieux, MacLeod and Parent (2009) asserts that as a result of imperfect information about workers, high ability workers will have an incentive to sort into performance pay jobs so that they can reveal their high productivity and receive wages that more closely reflect their abilities. Lemieux, MacLeod and Parent support this argument by comparing the average AFQT score of the workers in performance-pay jobs with AFQT scores of the workers in non-performance-pay jobs. Adopting their view on performance pay jobs, one can categorize sorting into performance pay as a means to reveal the productivity of the workers. Thus, given the functions of higher education, the relation between ability and having performance pay job will be different among high school and college graduates. To be more specific, since high school graduates are pooled with each other at the beginning of their careers, high ability high school graduates will try to sort into performance pay jobs and receive pay in relation to by their individual abilities. However, unlike high school graduates, college graduates are differentiated by their ability from the beginning of their careers. Thus, high ability college graduates will have little incentive to sort into performance pay jobs and pay additional monitoring costs to reveal their high abilities. In other words, it is not necessary for high ability college graduates to sort into performance pay jobs; in fact it could be considered wasteful in the early stages of their careers.

In sum, the probability of getting performance-pay jobs will depend positively on AFQT scores

among high school graduates in the early stages of their careers, whereas *among* college graduates the correlation between working at performance pay jobs and AFQT scores will not be positive.⁶

3.3 Job Mobility

The positive relationship between wage increases and job mobility for young high school graduates has been well documented by Topel and Ward (1992). They interpret the results as supportive evidence for the search theory and view job mobility as an important means for wage increases and as a step toward stable long-term employment for high school graduates.⁷

In my paper, the positive return of job mobility among high school graduates is viewed as a result of the positive return to productivity revealing behavior. More concretely, high ability high school graduates will have higher job mobility than low ability high school graduates as they engage in productivity revealing activities to differentiate themselves from their low ability counterparts so that they can move to better jobs in the early stages of their careers. Thus, there will be a positive relation between wage increases and job mobility, as high ability high school workers move to better jobs with higher wages. Moreover, as the high ability high school graduates obtain the jobs they deserve, the incentive to move to other jobs will decrease, and, their careers will eventually stabilize over time. This reasoning implies that the negative relationship between job mobility and potential experience will be steeper for the high ability high school graduates than for low ability high school graduates.

However, since college graduates are offered jobs according to their individual abilities from the beginning of their careers, high ability college graduate workers will not have an incentive to move between jobs at the cost of firm-specific human capital. That is, high ability college graduate workers will not have to engage in costly job searches and related job mobility to separate themselves their low ability counterparts in the early stages of their careers. Moreover, since high ability college graduates do not have high job mobility at the beginning of their careers, relationships between job mobility and potential experience will not differ across ability among college graduates.

⁶The difference in the probability of sorting into performance pay jobs *between* the high school and college graduate workers can still exist. To be more specific, college graduates are more likely to sort into performance pay jobs. This fact does not contradict the model since the difference *between* average high school and college graduates can be explained by other factors such as the differences in job characteristics of college and high school graduates

⁷Unlike Topel and Ward(1992), Neumark(2002) views job mobility as a wasteful procedure. He shows that the judgment of the job mobility can be different between high school and college graduates.

4 Data

To verify the predictions regarding productivity revealing activities and job mobility of workers, I use NLSY79 data for the 1979-2006 period. The data have been collected annually since 1979 and biannually since 1994. The respondents were aged between 14 and 22 at the beginning of the survey. These data have a number of advantages for analyzing post-schooling signaling behavior. First, productivity revealing activities are most likely to be important in the early stages of workers' careers, and NLSY79 is precisely focused on this part of the life cycle. Second, for the analysis of post-schooling behavior proposed here one needs information about ability of the workers. NLSY79 contains the results of the AVSAB test which can be converted to an AFQT score. The AFQT score in NLSY79 has been widely accepted as a pre-market measure of ability (or cognitive skill). Third, NLSY79 contains longitudinal information that enables the researcher to determine the workers' transitions into the labor force. This information allows one to calculate potential experience which is more precise than using the usual arbitrary definition of potential experience (age-highest grade-6). Lastly, the data have detailed information about the training of workers and their job characteristics, including the payment structure of the jobs.

For the main analysis, I restrict the sample to white males in order to avoid tracking the variations in careers that might arise from differences in race and/or gender. Following ABH (2010), I also limit the sample to respondents who have completed 12 or 16 years of education and ignore high school dropouts and individuals who have completed some college education. I do not include respondents who have military jobs or, jobs without pay, are self-employed in CPS (main) jobs or work for a family business. I also exclude labor market experience accumulated before individuals left school for the first time. The potential experience is defined as the number of years since the respondents first finished schooling.

Furthermore, I restrict the analysis to individuals for whom potential experience is less than 13 years, thereby focusing on the early stages of their careers. Another reason for this sample selection, as explained in ABH (2010), is to keep the analysis simple by focusing on the approximately linear region of the relation between log wages, AFQT scores, and potential experience.

The measure of ability, AFQT, is constructed using the definition provided by the Department of Defense, and is standardized by the age of the individual at the time of the test. The construction of the performance pay indicator variable follows LMP (2009). The performance pay indicator takes a value equal to one if the wages of CPS jobs includes a variable pay component such as a

bonus, commission or piece-rate. For the off-the-job training variable, I follow Parent (1999) and re-classify 12 training categories into three groups—on-the-job training (OJT), off-the-job training (OFT), apprenticeship. The OFT indicator variable takes the value one if the respondent took any form of OFT—business colleges, nursing programs, vocational-technical institutes, etc.—in a given year. I use the hourly wage rate of the CPS job from the work history file as a measure of wages and obtain the real wage by using the CPI index. The number of jobs in a given year is used as a proxy for the job mobility of workers.

[Table 1 about here]

Table 1 shows summary statistics for the main analysis sample. As expected, the average of log wages and the average AFQT scores are higher for the college graduates than for the high school graduates. College graduates are also more likely to sort into performance pay jobs and to obtain training. Additionally, the composition of the training differs across the two groups as high school graduates are more likely to obtain OFT and apprenticeships and are less likely to obtain OJT. However, there is little difference in the number of jobs per year between college and high school graduates.

5 Identification Strategy and Empirical Specification

The scarcity of exogenous variations that induce people to engage in college education makes documenting the effect of college education challenging. There have been a few paper such as Card (1993) and Currie and Moretti (2003) that exploits distance to college and college opening as an instrument for higher education. However, the validity of the instrument is perhaps more open to question—due to the endogenous location of individuals and colleges—relative to other instruments that induce people to take additional K-12 schooling, such as change in a compulsory schooling law.

My paper sidesteps this issue by following ABH (2010) and documents the different relationship between ability and outcomes *across* high school and college graduates. I claim this difference as evidence supporting the effects of higher education on the subsequent careers of the workers.⁸ Particularly, I verify a positive and statistically significant relationship between the incidence of productivity revealing activities and ability *among* high school graduates, and a similar non-

⁸ABH (2010) assert the difference in the statistical significance of the key coefficients across the two groups as an evidence for the productivity revealing function of college education

positive relationship *among* college graduates. I attribute this difference across the two groups to the differences in the productivity revealing activities across the two groups given the functions of college education.

The main empirical specification follows employer learning literature (Altonji and Pierret (2001)) and regresses the outcome variable on a measure of ability, potential experience and the interaction between the two. The following equation will be estimated separately for high school and college workers:

$$Y_{it} = \beta_0 + \beta_1 AFQT_i + \beta_2 Exp_{it} + \beta_3 AFQT_i * Exp_{it} + f(Exp_{it}) + \delta_t + \Phi' X_{it} + \epsilon_{it} \quad (1)$$

where Y_i is the outcome variable such as the wages of the workers, number of jobs held in a given year and the dummy variable for having performance pay jobs and engaging in off-the-job training. The coefficient of the $AFQT_i$, β_1 , indicates the correlation between the outcome variable and AFQT scores at the beginning of an individual's career—when their potential experience is equal to zero. The coefficient of the interaction term, β_3 , captures difference in correlation between experience and outcome across different ability of workers. The prediction of the model will be supported by examining difference in statistical significance and the sign of coefficients in each group. To be more concrete, β_1 and β_3 are expected to be positive and negative respectively for high school graduates. On the other hand, for the college graduates, the coefficients for AFQT scores and the interaction term are expected to be non-positive and non-negative respectively.

For testing the implications of performance pay jobs, the main specification will only have the AFQT score and a measure of potential experience as an independent variable due to the data limitation.⁹ Thus, the implication of the model will be verified by looking at whether there is a difference in the relation between having a performance pay job and ability in the first 13 years of an individual's career across the two groups.

⁹The data from the question about performance job are collected between 1988~1990 and 1996~2000 when most of respondent had gained over 7 to 8 years of potential experience. As a result, the estimation of β_1 in equation (1) which estimates the AFQT scores and outcome at the beginning of workers' careers will be unreliable. Moreover, since the collection of information about performance pay is not continuous, β_3 which estimates the relation between performance pay and experience will also be unreliable. Thus, I only look at whether sorting into performance pay depends on AFQT for the first 13 year of workers' careers. The prediction of the model implies that the AFQT coefficient will be positive and significant for high school graduate but insignificant for the college graduates.

6 Results

This section provides the empirical results that verify the prediction of the model for productivity revealing activities and job mobility of workers. Before presenting the main results, I first replicate the main result of ABH (2010) to show the productivity revealing function of higher education.

6.1 Replication of ABH (2010)

Table 2 shows the replication of ABH (2010). The results are qualitatively similar to ABH (2010), for both college graduates and high school graduates. The AFQT coefficient in column(3) is positive but small and statistically insignificant, which implies that the wages of the high school graduates do not reflect their cognitive abilities at the beginning of their careers (when their potential experience is zero). The coefficient on the interaction term between AFQT scores and potential experience is positive and significant, which implies the wages of high school graduates eventually reflecting their individual abilities. In other words, the high school graduates are pooled with each other at the beginning of their careers and then get separated by AFQT scores with time.

[Table 2 about here]

The results for college graduates tell a different story, and the AFQT coefficient in column(6) is sizable, positive and significant whereas the interaction term is small and insignificant. Thus, unlike high school graduates, college graduates are separated by their AFQT scores from the beginning of their careers, and the additional separation associated with experience is insignificant. Figure 2 and Figure 3 below illustrate the wage dynamics for high school and college graduates.

[Figure 2 and Figure 3 about here]

Taking into account that the variations in AFQT score are much smaller among college graduates than among high school graduates, this result seems to provide strong support that higher education fulfills a role for productivity revealing. Moreover, the result also provides evidence against the assertion that state job mobility and productivity revealing are due to the different amounts of variance in AFQT scores between each group.

6.2 Job Mobility(Number of Jobs)

Table 3 describes the results for the job mobility of workers. As expected, the job mobility of high school graduates is positively related with ability at the beginning of their careers. The coefficient

of AFQT in column (3) is positive and significant at the 5% level. In particular, one standard deviation increase in AFQT is associated with 0.12 more jobs per year in the early stage of high school graduates' career. The coefficient for the interaction term is negative and significant for high school graduates. This result coincides with the career of high ability high school graduates eventually stabilizing over with time. In other words, the potential experience gradient is steeper for high ability high school graduates since they will take more jobs in the beginning of their careers than low ability high school workers will take, although they will have similar job mobility later in their careers. Column (1) also shows that the job mobility in the first 13 years of a career is positively related with ability for high school graduates.

[Table 3 about here]

However, the results for college graduates display different patterns between ability and job mobility. The data in column (6) suggest that, unlike the high school graduates, job mobility does not depend on AFQT scores for college graduates. Both AFQT scores and the interaction term coefficient are statistically insignificant for college workers. These data suggest that factors, such as the random job match quality between employers and employees, which will not depend on the abilities of workers, might be a major determinant of the job mobility among young college graduates. The results from column (4) also show that job mobility and ability are not positively related in the first 13 years of college graduates' careers.

Overall, the results show that job mobility has different patterns among high school and college graduates. These differences could shed light on the source of return from job mobility which is described in Topel and Ward (1992). The results suggest that the return from job mobility among high school graduates arises from the correlation between ability—which is positively related with wages in the long run—and job mobility. Moreover, given the positive return from firm specific human capital, different patterns of job mobility also suggest a possible source of positive pecuniary returns from higher education. Since average job mobility, measured by the number of jobs in a given year, is similar between high school and college workers, the results imply that high ability high school graduates will have higher job mobility than *both* low ability high school graduates and low ability college graduates in the beginning of their careers. Thus, the low ability college graduates will accumulate more firm specific human capital than high ability high school workers and can accelerate their wage growth as they do not have to move across jobs as high ability high school graduates (Neumark (2002)). Since most of the literature documents the return of higher education by comparing high ability high school graduates and low ability college graduates, these results

could be further interpreted as a source of the monetary return to higher education documented in those papers.

[Figure 4 and Figure 5 about here]

6.3 Post Schooling Productivity Activity (Off the Job Training and Performance Pay Jobs)

Table 4 summarizes the results of off-the-job training. The probability of taking OFT does not depend positively on the AFQT scores of college graduates in the early stages of their careers as the AFQT coefficient in column (6) is negative and not statistically significant at 5%. Further, the interaction term between AFQT scores and potential experience is positive which would reject the possibility of OFT being used as a productivity revealing device for high ability college graduates. If OFT is used as a productivity revealing device, it should be used more intensively by high ability college graduates in the early stages of their careers. Overall, the evidence supports the view that for college graduates, productivity revealing is not a dominant motivation for receiving OFT. Column (4) shows that there is little correlation between the incidence of off-the-job training and ability in the first 13 years of the careers of college graduates.

[Table 4 and Table 5 about here]

However, for high school graduates, the results coincide with the prediction that high ability high school graduates will use OFT as a mean for productivity revealing. The AFQT coefficient in Column (3) is positive and significant implying that at the beginning of careers, high ability high school graduates are more likely to engage in OFT than their low ability counterparts. Moreover, the interaction term between AFQT scores and potential experience is negative which implies high ability high school graduates are more likely to undertake OFT at the beginning of their careers compared to low ability high school graduates. This result also coincides with the prediction of the model since the return of the productivity revealing component of OFT is higher in the early stages of a career, and high ability high school graduates will engage in OFT more intensively in the earlier stages of their careers.

The results for workers sorting into performance pay jobs also show evidence of different productivity revealing behaviors across high school and college graduates. As described in Table 5, column (1), the probability of sorting into performance pay jobs depends positively on AFQT scores for high school graduates in the first 13 years of their careers. However, for college gradu-

ates AFQT scores do not affect the probability of obtaining performance paid jobs during the early stages of their careers as the coefficient in Column in (4) is not statistically significant. Moreover, although the results are not reliable due to data limitations, Column (3) and Column (6) also show that estimation result using the potential experience and the interaction term between AFQT scores and experience are fairly consistent with the prediction of the model.

Based on the results discussed in this section, Figures 4 and 5 illustrate the different patterns of job mobility and productivity revealing activities across high school and college graduates. Overall, it seems that the results of this section fit the prediction of the model, thus, supporting evidence on the effects of higher education on the subsequent careers of workers.

7 Comparison with Employer Learning Literature

Since the seminal work by Farber and Gibbons (1996), the role of the employer learning on wage dynamics—the wages of young workers eventually being positively related with AFQT scores—has been well documented by several papers (Altonji and Pierret (2001) and Bauer and Haisken-DeNew (2001)). The basic employer learning model hinges on the public or symmetric employer learning which assumes that the current employer's information about the workers is being shared with *all* potential employers. However, the existence of private or asymmetric learning of employers—and the game theory issues related to it—makes the plausible mechanism of employer learning complicated. As a result, only a small number of papers (Schoenberg (2007) and Pinkston (2009)) proposed an employer learning mechanism that explains wage dynamics under the private or asymmetric learning of employers. However, given the high mobility of high school graduates in the early stages of their career (Topel and Ward (1992)), it seems unrealistic that information about average young workers could be accumulated in a short time and then passed to outside employers through a rather complicated process without a significant amount of loss in the information.

By focusing on the incentives of high ability workers to reveal their productivity, this paper provides an alternative story for the wage dynamics of young workers. Unlike the employers who do not have an incentive to reveal information about their high ability workers, the high ability workers have incentive to reveal their abilities to their potential employers through productivity revealing activities. The property of the productivity revealing activity will simplify analysis of wage dynamics since one does not have to consider the transmission of information across employers. Moreover, explaining the wage dynamic using the incentives of workers is more intuitive

than relying on employer learning as it emphasizes the role of workers who will actually gain from productivity revealing and the related wage increases.¹⁰

8 Conclusion and Discussion

In this paper, I documented the effects of the productivity revealing function of higher education on the subsequent careers of individuals. Unlike the traditional signaling and human capital accumulating functions, the productivity revealing function of higher education yields a simple and unambiguous prediction on the subsequent productivity revealing activities of high school and college graduates. Using a model that extends the traditional signaling model, I linked the decision to sort into higher education and subsequent productivity revealing activities of individuals.

Given the productivity revealing function of higher education, the model predicts active productivity revealing behavior for high ability high school graduates and little productivity revealing activity for high ability college graduates. Thus, for the high school graduates, the productivity revealing activity will be positively related to ability since the high ability high school graduates will engage in activities to separate themselves from low ability high school graduates. However, among college graduates, productivity revealing activities and ability will not be positively correlated since the high ability college graduates are already distinguished from low ability college graduates and have little incentive to engage in costly productivity revealing activities. Moreover, I predict that high ability high school graduates will have higher mobility than low ability high school graduates at the beginning of their careers as they are differentiated from low ability high school graduate workers and move to the better jobs. Unlike high school graduates, the job mobility of college graduates will not positively depend on ability since the high ability college graduates will have decent jobs from the beginning of their career and will not have an incentive to move between jobs at the cost of firm specific human capital. Using NLSY79 data, I tested the prediction of the model by regressing the measure of job mobility and productivity revealing activities on the measure of ability separately for high school graduates and college graduates. Overall, the data verify the predictions of the model well.

The model and the supporting empirical results illustrate the importance of the function of higher education in understanding the subsequent careers of high school and college graduates.

¹⁰The employers will be indifferent about the wage distribution in this setting as long as the average wage equals the average productivity of workers.

Thus, the traditional signaling model and the employer learning literature that categorize young workers into two groups—high school and college graduates—is misleading since the employers will more closely observe heterogeneity among college graduates. I believe acknowledging the productivity revealing function of higher education will improve the traditional signaling theory, giving it richer empirical implications.

Moreover, this analysis demonstrates the importance of the productivity revealing activities of workers which have been ignored in previous literature. Previous papers have assumed that workers' productivity revealing activities ended when the workers finished schooling.¹¹ Thus training—regardless of its type—has been mostly analyzed under the human capital framework. Further, the job mobility of workers was viewed under the search theory framework that emphasized the limited ability of workers to evaluate the employers. Contrary to the previous literature, this paper views the incidence of off-the-job training and the job mobility of young workers as a result of productivity revealing activities. This study also supports this view by verifying that productivity revealing activities will more likely be undertaken by the group of workers whose benefit from the activity is larger than that of their counterparts.

Lastly, the different degree in asymmetric information across high school and college graduates has implications for the wage distribution. For instance, under the assumption of assortative matching, increases in heterogeneity across colleges in terms of student ability will not only increase the inequality within college graduates (Hoxby and Long (1999)) but will also increase the mean wage difference between college and high school graduate workers (Maskin and Kremer (1996)). That is, as the employers can observe the individual abilities of college graduates more closely, the assortative matching between college graduates and employers will prevail, and *both* spread and mean wage of college workers will increase compared to the wages of high school graduates.

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¹¹Lemieux, MacLeod and Parent (2009) is a notable exception

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Table 1: **Summary Statistics**

	High School		College		Total	
	Mean	S.D	Mean	S.D	Mean	S.D
AFQT	0.2303	0.7761	1.2391	0.4569	0.4753	0.8329
Number of jobs per year	2.2212	0.9003	2.2025	0.7362	2.2167	0.8641
Log of real wage	6.4233	0.4856	6.8430	0.5913	6.5227	0.5428
Potential experience	6.4272	3.2861	5.6792	3.3683	6.2495	3.3210
% Performance pay	23.21		42.64		29.69	
Training (%)	9.42		16.94		11.21	
% On the job training	34.12		61.11		43.81	
% apprenticeship	10.65		0.51		7.01	
% Off the job training	55.23		38.38		49.18	
Region(%)						
Northeast	19.25		25.82		20.8	
North Central	36.73		30.79		35.32	
South	27.66		28.06		27.75	
West	16.36		15.32		16.12	
Urban residence(%)	70.89		86.73		74.60	
Observations	11258		3507		14765	
# of individuals	1815		569		2384	

Average and standard deviations are calculated over individual by year observation coming from a panel from 1979-2006.

Table 2: Replicating ABH (2010)

Model	High School			College			Test : College=HS P-value		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AFQT	0.0844*** (0.00624)	0.00789 (0.0122)	0.00202 (0.0124)	0.162*** (0.0204)	0.128*** (0.0386)	0.118*** (0.0390)	0.000	0.001	0.001
Exper	0.102*** (0.0137)	0.0920*** (0.0137)	0.0961*** (0.0139)	0.102*** (0.0327)	0.0941*** (0.0333)	0.0859** (0.0337)	0.801	0.586	0.683
AFQT*Exper/10		0.120*** (0.0180)	0.119*** (0.0182)		0.0617 (0.0588)	0.0738 (0.0587)		0.338	0.442
Observations	10,280	10,280	9,984	3,279	3,279	3,140			
R_sq	0.112	0.116	0.128	0.132	0.132	0.144			
Additional Controls	No	No	Yes	No	No	Yes	No	No	Yes

All specification includes year fixed effect and a cubic in potential experience. Specification (3) and (6) additionally controls for region of region and urban residence. In column (7), I report the p-values for the difference in the coefficients of specifications (1) and (3). Similarly, specification (8) and (9) compares (2) and (4) and (3) and (6) respectively. The White/Huber standard errors in parenthesis control for correlation at the individual level.

*** statistical significance at the 99% level

** statistical significance at 95% level

* statistical significance at 90% level

Table 3: Number of Jobs

Model	High School			College			Test : College=HS P-value		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AFQT	0.0389*** (0.0110)	0.126*** (0.0255)	0.126*** (0.0257)	-0.0738** (0.0295)	-0.0970 (0.0699)	-0.0971 (0.0710)	0.000	0.000	0.001
Exper	-0.0643** (0.0310)	-0.0528* (0.0311)	-0.0453 (0.0315)	0.106** (0.0439)	0.100** (0.0473)	0.0875* (0.0483)	0.014	0.024	0.030
AFQT*Exper/10		-0.137*** (0.0327)	-0.135*** (0.0328)		0.0420 (0.0942)	0.0301 (0.0950)		0.053	0.139
Observations	10,559	10,559	10,254	3,386	3,386	3,238			
R_sq	0.029	0.031	0.035	0.082	0.082	0.082			
Additional Controls	No	No	Yes	No	No	Yes	No	No	Yes

All specification includes year fixed effect and a cubic in potential experience. Specification (3) and (6) additionally controls for region of region and urban residence. In column (7), I report the p-values for the difference in the coefficients of specifications (1) and (3). Similarly, specification (8) and (9) compares (2) and (4) and (3) and (6) respectively. The White/Huber standard errors in parenthesis control for correlation at the individual level.

*** statistical significance at the 99% level

** statistical significance at 95% level

* statistical significance at 90% level

Table 4: Off-the-Job Training

Model	High School			College			Test : College=HS P-value		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AFQT	0.0111*** (0.00268)	0.0255*** (0.00601)	0.0238*** (0.00603)	-0.000465 (0.00928)	-0.0291* (0.0172)	-0.0287 (0.0177)	0.255	0.002	0.003
Exper	-0.0253*** (0.00771)	-0.0234*** (0.00767)	-0.0223*** (0.00774)	0.0150 (0.0116)	0.00768 (0.0125)	0.00817 (0.0127)	0.008	0.054	0.068
AFQT*Exper/10		-0.0227*** (0.00866)	-0.0216** (0.00867)		0.0518* (0.0274)	0.0518* (0.0280)		0.006	0.008
Observations	10,559	10,559	10,254	3,386	3,386	3,238			
R_sq	0.015	0.015	0.017	0.022	0.023	0.025			
Additional Controls	No	No	Yes	No	No	Yes	No	No	Yes

All specification includes year fixed effect and a cubic in potential experience. Specification (3) and (6) additionally controls for region of region and urban residence. In column (7), I report the p-values for the difference in the coefficients of specifications (1) and (3). Similarly, specification (8) and (9) compares (2) and (4) and (3) and (6) respectively. The White/Huber standard errors in parenthesis control for correlation at the individual level.

*** statistical significance at the 99% level

** statistical significance at 95% level

* statistical significance at 90% level

Table 5: Performance Pay Jobs

Model	High School			College			Test : College=HS P-value		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AFQT	0.0335*** (0.0109)	0.105** (0.0505)	0.102** (0.0508)	-0.0503 (0.0326)	-0.154** (0.0720)	-0.149** (0.0726)	0.014	0.004	0.004
Exper	0.00888 (0.0728)	-0.00428 (0.0736)	-0.000391 (0.0741)	0.237*** (0.0633)	0.219*** (0.0646)	0.223*** (0.0655)	0.020	0.025	0.038
AFQT*Exper/10		-0.0785 (0.0545)	-0.0768 (0.0547)		0.164 (0.103)	0.166 (0.103)		0.047	0.030
Observations	2145	2145	2,128	1093	1,093	1,076			
R_sq	.009	0.010	0.014	0.019	0.022	0.031			
Additional Controls	No	No	Yes	No	No	Yes	No	No	Yes

All specification includes year fixed effect and a cubic in potential experience. Specification (3) and (6) additionally controls for region of region and urban residence. In column (7), I report the p-values for the difference in the coefficients of specifications (1) and (3). Similarly, specification (8) and (9) compares (2) and (4) and (3) and (6) respectively. The White/Huber standard errors in parenthesis control for correlation at the individual level.

*** statistical significance at the 99% level

** statistical significance at 95% level

* statistical significance at 90% level

At stage one, people above ability cutoff sort into high education and become college graduates

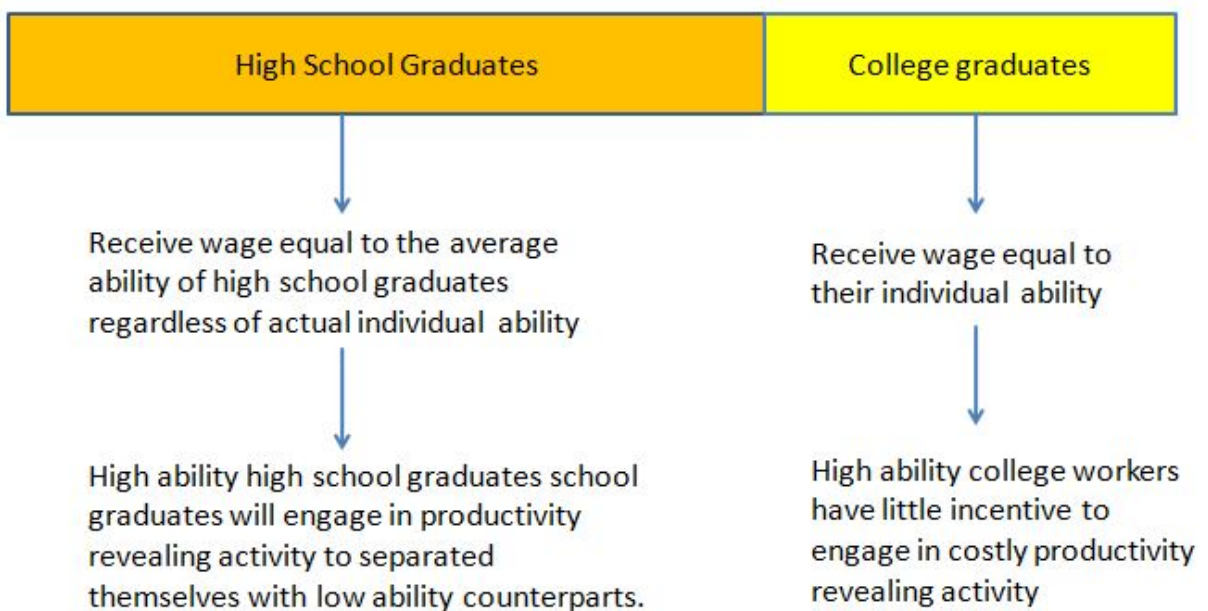


Figure 1: Illustration of the Two Stage Model

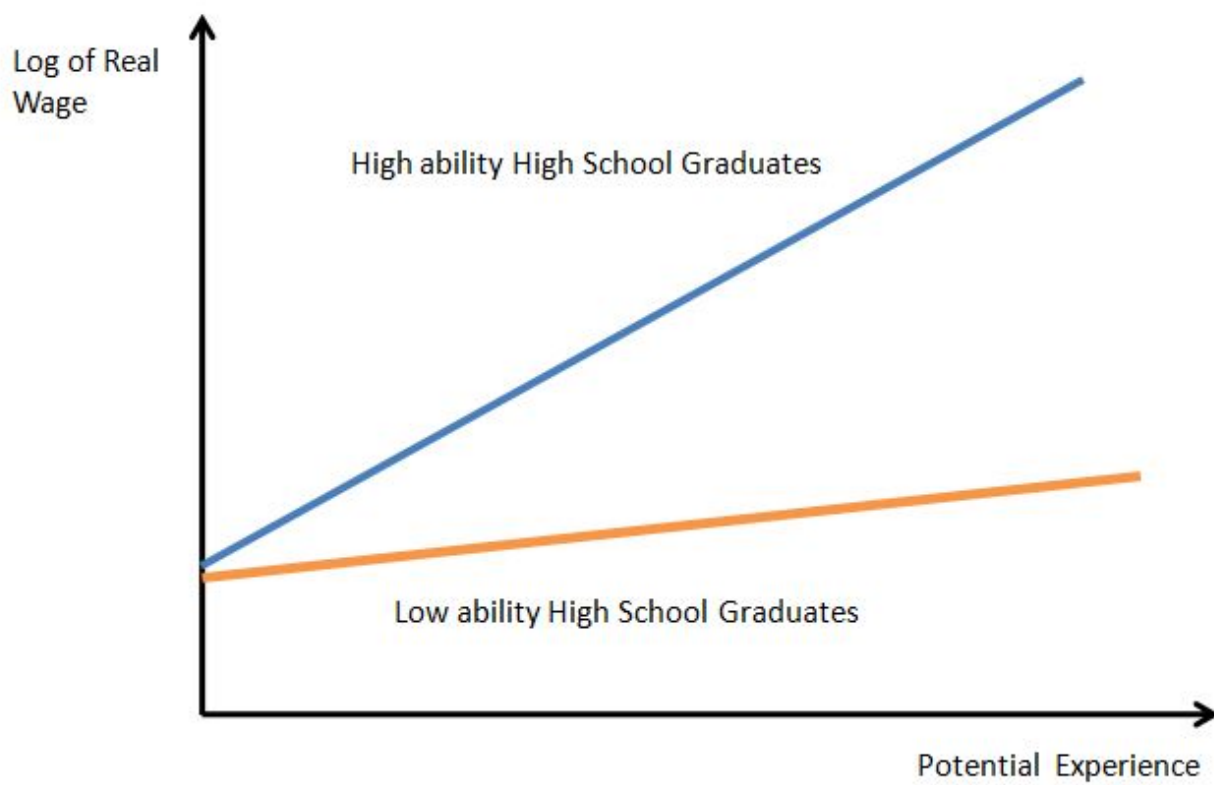


Figure 2: Illustration of Wage Dynamics among High School Graduates

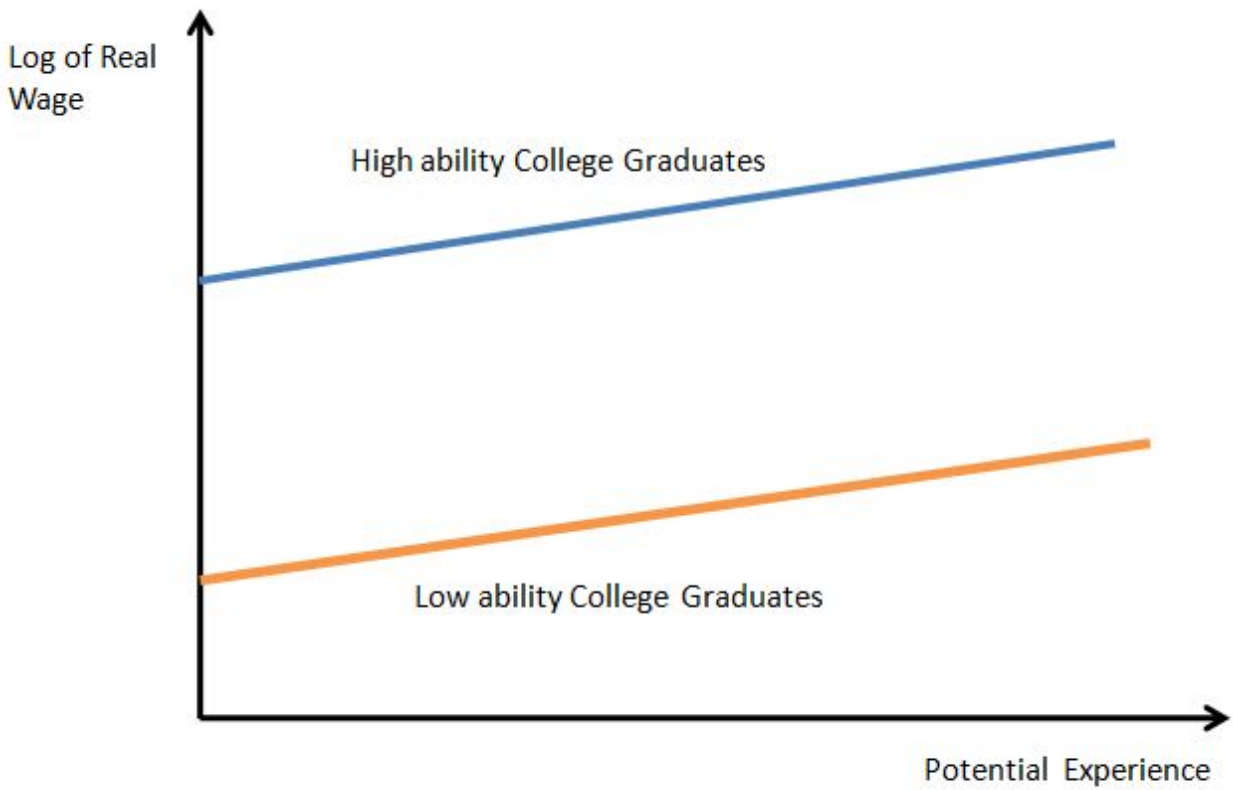


Figure 3: Illustration of Wage Dynamics among College Graduates

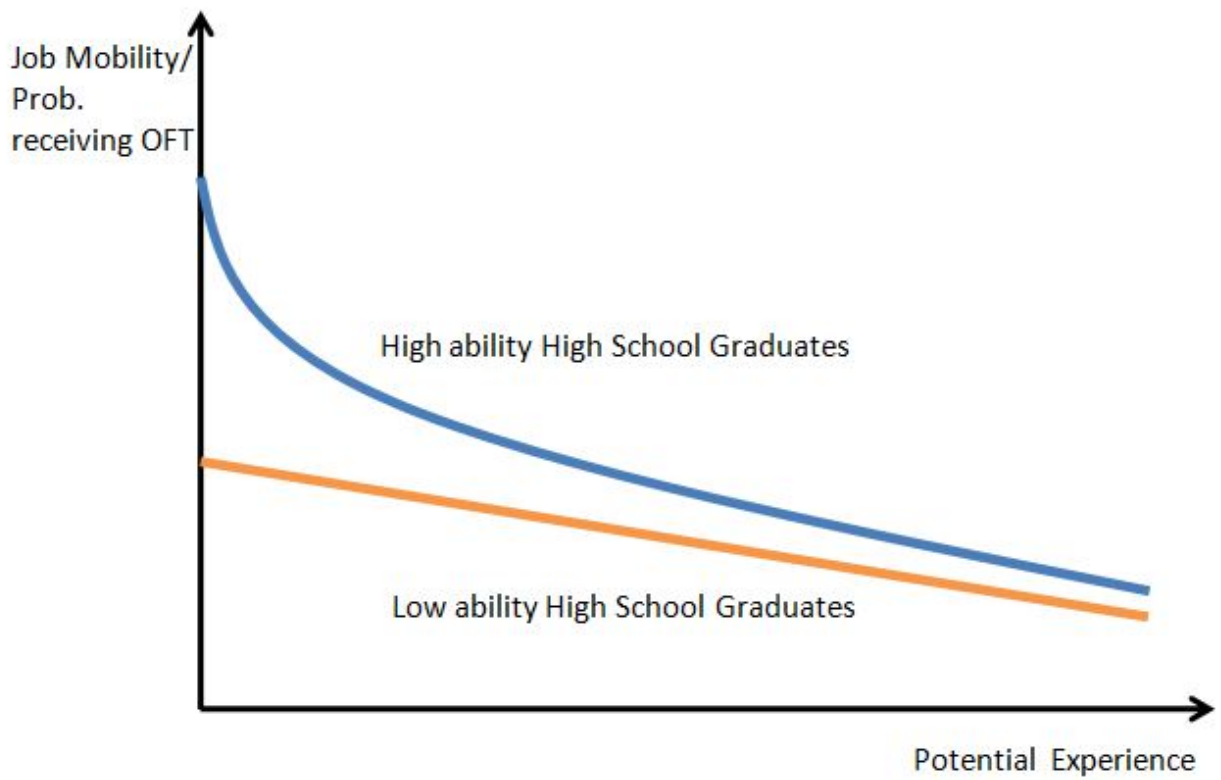


Figure 4: Illustration of Post-Schooling Productivity Activity for High School Graduates

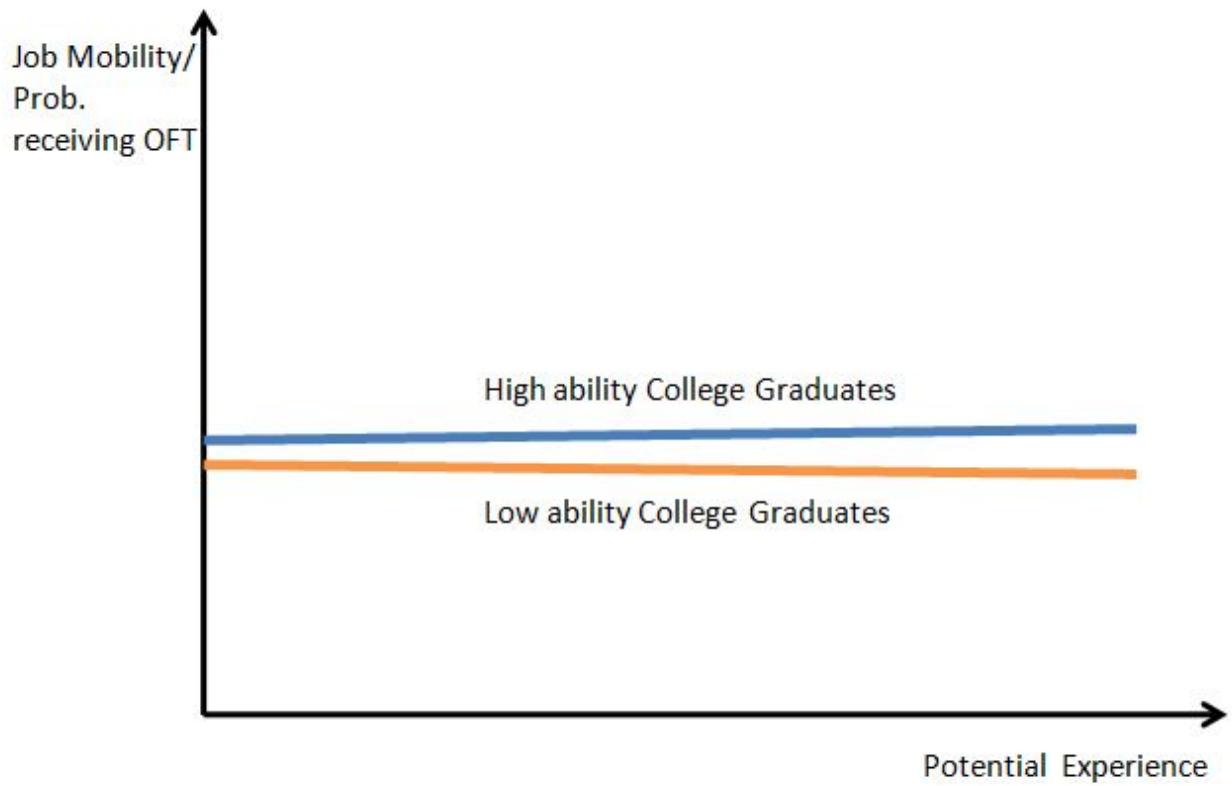


Figure 5: Illustration of Post-Schooling Productivity Activity for College Graduates