The Impact of Human Capital in the American Labor Market Series

Skills and Earnings in the Full-Time Labor Market

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Preface

This paper is the first in a series of policy reports dealing with the impact of human capital investments on the U.S. labor market. It is part of a larger series of papers from the ETS Center for Research on Human Capital and Education that uses data from the *Programme for the International Assessment of Adult Competencies* (PIAAC) to better understand the relationship between human capital and opportunity in America today.

Neeta Fogg, Paul Harrington, and Ishwar Khatiwada, labor economists from Drexel University's Center for Labor Markets and Policy, dive deep into the rich data of PIAAC to examine three measures of human capital: educational attainment, cognitive skills, and work experience of prime-age (25 to 54 years old), full-time employed workers in the United States. Through detailed descriptive data and a host of multivariate regressions, the authors report the impact on earnings across each component of human capital. What they reveal is a complex and multifaceted story, one where the earning gains from additional levels of education can be large, but are not universally shared.

A central theme in this paper is that higher educational attainment largely translates to improved employment and earnings outcomes. For example, the earnings of full-time workers age 25 to 54 who dropped out of high school are 16 to 17 percent below the earnings of their peers who graduated high school, while those with a bachelor's degree see a 30 percent gain over high school graduates, and those with a master's degree are expected to earn around 45 percent more than high school graduates. However—and this is a critical caveat—these findings do not apply across all levels of higher education. In fact, the authors found *no earnings advantages* for those with a postsecondary certificate, or for those who attended college but did not earn a credential, when compared to high school graduates. Workers with an associate's degree had only a small earnings advantage over high school graduates.

Where the authors do find consistent—and strong—gains in labor market outcomes is in individuals' literacy and numeracy skill levels, reporting that the earnings of prime-age, full-time workers at *every level of education* increased with higher levels of literacy and numeracy skills. Their research indicates that a college education accounts for only part of the earnings premium of college-educated workers over high school graduate counterparts. The balance of the wage premium appears to be tied to cognitive skills, which are rewarded in the labor market because they improve worker performance.

Researchers and others tend to use educational attainment alone as the "stand-in" for human capital because of the wide availability of attainment data in public datasets. But as a measure, the authors argue, it is deeply imprecise and "far from a standardized product." Most importantly, it does not directly impart information on cognitive skills, but instead roughly aligns to an expectation of those skills—an expectation that appears to be increasingly dubious. The authors demonstrate this when they report that on the PIAAC literacy scale, some 36 percent of full-time, prime age workers with an associate's degree performed at low levels, as did some 18 percent of those with a bachelor's and 13 percent of those with a master's degree or higher. On the numeracy scale, the results were even more disappointing. Here the percentages with low skills ranged from nearly 50 percent among those with an associate's degree to 30 percent with a bachelor's to 20 percent with a master's degree or higher.

The contradiction between greater educational attainment levels and low skill proficiencies is also apparent in other research using PIAAC data published in our Center, as well as mirrored in analyses of the National Assessment of Educational Progress (NAEP, or "The Nation's Report Card") and the Organisation for Economic Co-operation and Development's Programme for International Student Assessment (PISA). In most cases and across core domains such as reading, math, and scientific literacy, we see aggregate skill levels among both student and adult populations that are either flat or in decline in spite of increases in educational spending and attainment.

Why do these contradictions remain despite increased awareness of the problem and despite the fact that we continue to invest in efforts to reduce poverty and improve schooling? Some believe the contradictions we see between attainment levels and skill levels have to do with the organization of the schools; others believe it has to do with inadequate spending and an unwillingness to take any major steps to make schools better. We at the Center for Research on Human Capital and Education have argued that while these are important factors related to the inequality we see in outcomes, a deeper problem has to do with the varied backgrounds and opportunities that children have before they enter school and the accumulation of disadvantages they experience from birth through the elementary and high school years.

From a policy perspective, as the authors say, when the goal is attainment, we run the risk of "overemphasizing policies designed to increase the level of educational attainment of the population with little regard to developing basic skills in that education process." Moreover, resources known to bolster skills may be overlooked for programs and policies that singularly promote attainment. This has stark social and economic consequences. Those who invest their effort, time, and money in the pursuit of postsecondary education anticipating an increase in their levels of human capital may be putting themselves and their future at risk. When this happens for many, it also puts society at risk.

Understanding the complex and interrelated dynamics associated with the development of human capital is a first and critical step toward improving the distribution of it in our population. It is this goal that we should be marshaling our resources to achieve.

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The authors first and foremost wish to acknowledge Irwin Kirsch and Anita Sands of the Center for Research on Human Capital and Education at ETS. Irwin and Anita brought us into the world of the Programme for the International Assessment of Adult Competencies (PIAAC) and encouraged us to prepare this first in a series of monographs using its extraordinary data to better understand the impact of foundational skills on the labor market experiences of American adults. Too often, those in the policy arena conflate educational attainment with skills and abilities that are valued in the labor market. As we prepared the final touches of this monograph, the Census Bureau released a new report celebrating the achievement of 90 percent of American adults earning a high school diploma. Yet the PIAAC findings suggest a worrisome disconnect between the educational attainment of adults and their literacy and numeracy skills. Irwin and Anita have pushed us to explore this disconnect and examine its meaning in the American labor market.

We also want to acknowledge Brian McMahon of Virginia Commonwealth University and Robert Nakosteen of the University of Massachusetts Amherst, who generously served as external peer reviewers for this paper. The insights and experience they bring to the review process are extraordinary. We would also like to acknowledge the internal review team at ETS led by John Sabatini, who served as a skilled hand in managing the review process and providing us with constructive comments from his team. Larry Hanover provided a strong and steady hand editing and very much improving our original manuscript. Larry is a skilled editor and a true gentleman. Our Drexel University colleague Laura Knoll provided important research and editing support along with an amiable demeanor that makes us value her work all the more.

Dedication

We would like to dedicate this report to our friend, mentor, and a great American: Andrew M. Sum, Professor Emeritus of Northeastern University.

Note to Reader

The appendices to this report can be found online. Please visit https://www.ets.org/research/report/earnings-full-time-labor-market/.

Executive Summary

Research on labor market gains associated with investments in human capital most frequently relies on years of schooling completed, or educational credentials, as a measure of human capital. Indeed, it is commonplace in speeches by college presidents to touch upon the increased earnings associated with a college education.

Clearly, the claim is backed by strong evidence. Over the past four decades, the size of the average earnings advantage for completing a bachelor's degree has grown substantially. Large increases in college enrollment rates among young people have resulted—as have large increases in college tuition and fees and skyrocketing student debt.

Yet while the gains from a college education can be quite large, that's not the whole story. Like any investment activity, the economic payoffs do not accrue to everyone. This paper raises the specter that, under some conditions, college enrollment may offer no economic benefit at all.

Using newly available data on the literacy and numeracy proficiencies of American adults produced by the Survey of Adult Skills of the Programme for the International Assessment of Adult Skills (PIAAC), this paper examines the independent effects of three key measures of human capital —basic skills, educational attainment, and work experience—on the earnings of prime-age (25 to 54 years old), full-time employed workers in the United States.

The study is designed to gauge the independent effect of each of these three measures of the human capital stock of workers on their earnings. In line with human capital theory, this study found a strong connection between earnings and each measure, with the details revealing strong gains for those with the most skills and education, but little or no gain, in one particular example, for those who fail to gain a bachelor's degree.

PIAAC provides an unusual opportunity to gain insights into these complex relationships for prime-age, full-time workers. Data on the literacy and numeracy skills for a nationally representative sample are difficult and expensive to produce and are not widely available, whereas data on educational attainment are regularly produced by the U.S. Census Bureau's household surveys. In fact, researchers have tended to use educational attainment as a stand-in for more complete measures of a person's human capital because of its availability.

Educational credentials, however, are not precise measures of basic skills proficiencies. For example, the reading and math scores of public high school graduates in Philadelphia vary enormously. Students from highly selective schools in the city of Philadelphia—where our Drexel University Center for Labor Markets and Policy is located—have the highest standardized test scores in Pennsylvania, while their counterparts enrolled in neighborhood high schools, just a mile or two down the road, have among the lowest.

Using PIAAC data, we find large earnings advantages to basic skills even after statistically controlling for the effect of educational attainment and other worker background characteristics and job traits for prime-age, full-time workers. These findings indicate that basic skills are not only fundamental to achieving higher levels of educational attainment but are also directly rewarded in the labor market in the form of higher earnings.

A summary of key findings includes:

- Higher levels of literacy and numeracy proficiencies for prime-age, full-time employed workers in the United States are associated with large earnings advantages. The earnings of workers with level 3 literacy/numeracy skills are one-third higher than those of their counterparts at level 2. Workers with the strongest basic skills (literacy/numeracy proficiency levels 4/5) earn about 75 percent more than their level 2 counterparts.
- Reflecting the role of basic skills in attaining academic credentials, we found a strong positive connection between basic skills and the level of educational attainment. The difference between the mean proficiency score of workers without a high school diploma and those with a master's degree or higher level of education was sizable: 108 points on the literacy measure and 109 on numeracy.
- However, the share with proficiency scores below level 3 was 40 percent in literacy and 50 percent in numeracy. Proficiency scores below level 3 are considered to be below the minimum standard of proficiencies associated with access to a range of social, economic, and educational opportunities.
- Furthermore, college degrees themselves do not necessarily reflect basic skill proficiencies. Thirty-six percent of those with an associate's degree scored below level 3 on the PIAAC literacy scale; 18 percent of those with a bachelor's degree and 13 percent of those with a graduate degree (master's or higher) did as well. Findings on the numeracy skills among college graduates were even more disappointing. Nearly half with an associate's degree scored below level 3 on the PIAAC numeracy scale; nearly 30 percent of those with a bachelor's degree and one-fifth of those with a graduate degree did as well.
- A set of regression models, estimated to disentangle the independent effect of each measure of human capital on earnings, found that work experience is a strong predictor of monthly earnings. An additional year of work experience is expected to increase monthly earnings by about 3 percent; the rate of earnings growth for each additional year of work experience is expected to slow down as the years of work experience increase.
- As expected, educational attainment is found to have a strong independent effect on earnings. Regression analysis found that the earnings of high school dropouts are expected to be 16 to 17 percent below the earnings of high school graduates, while workers with a bachelor's degree are expected to earn 30 percent more than their high school graduate counterparts, and those with a master's degree are expected to earn about 45 percent more than high school graduates.

- The regression analysis found little or no monthly earnings advantage associated with college education below the bachelor's degree level. Workers with a postsecondary certificate and those who attended college but did not earn a credential are found to have no statistically significant earnings advantage over high school graduates. Those with an associate's degree had only a small earnings advantage over high school graduates.
- Literacy and numeracy proficiencies are found to have a sizable positive influence on monthly earnings. The earnings regression analysis estimated that an increase of one standard deviation unit in the literacy/numeracy test score is expected to increase monthly earnings by about 8 percent.
- Lastly, the regression analysis also found a statistically significant earnings advantage of about 21 percent among those with level 4 or 5 literacy/numeracy proficiencies compared to workers with level 2 proficiencies. Level 3 proficiencies are expected to yield a statistically significant 7 to 8 percent earnings advantage compared to workers with level 2 proficiencies.

Introduction

The 2015 Human Capital Report of the World Economic Forum states that "talent" will be the key factor driving innovation, competitiveness, and economic growth in the 21st century, exceeding even physical capital (what accountants call tangible assets).[1] Talent, or "human capital" as it is known to economists in this context, represents the potential of human resources in the production of goods and services. Measured typically by formal educational attainment, human capital is the stock of knowledge, skills, abilities, behavioral characteristics, and other traits of individuals that contribute to this potential. Similar to physical capital development, the development of human capital requires individuals to invest in themselves, with future benefits expected to result.

Benefits from human capital investments are in large measure derived from gains in the cognitive capacity of individuals that make them more productive in the labor market.[2] While the gains to human capital investments are most often measured in the labor market, they also can be found in several dimensions of economic and social activities.[3]

The evidence that human capital and labor market success are closely connected is quite convincing. The connection between skills and success has strengthened over time as the industrial composition of employment in the U.S. economy has continued to shift from goods-producing industries (e.g., construction and manufacturing) to services-producing industries (e.g., health services, professional scientific, and technical services). Furthermore, the U.S. labor market has undergone unprecedented technological change with widespread "upskilling" and automation of routine jobs.[4] Technological advances have made the production of goods and services more human capital-intensive. They have altered the staffing patterns of industries, even in goods-producing sectors, toward occupations characterized by higher levels of human capital requirements that complement the increasingly sophisticated technologies and organizational processes used in production. These changes have increased the demand for—and tilted the labor market in favor of—workers with more educational attainment and higher levels of literacy, numeracy, and problem-solving proficiencies. Recent decades have also seen a rise in labor market rewards for noncognitive skills such as soft (or social) skills.[5]

Looking back at the past century, Goldin and Katz labeled the 20th century as the "Human Capital Century" and considered human capital to be the central determinant of economic growth and rising prosperity in the United States.[6] These trends are expected to intensify as human capital becomes an increasingly important driving force behind growth in the 21st century.[7]

The evidence of this transformation in the labor market is readily available. Workers with higher levels of education have better employment and earnings outcomes compared to those with lower levels of education. Higher levels of education are associated with higher rates of labor force participation, lower likelihood of unemployment, higher likelihood of employment, and more weeks and hours of work over the course of a year.

Earnings of workers rise sharply with their level of educational attainment. In 2014, the *median weekly earnings* of full-time workers aged 25 and older were just $488 among high school dropouts, rising to $668 among high school graduates, and $761 among those with some postsecondary education below the bachelor's degree level. Among college graduates, median weekly earnings were $1,101 among those with a bachelor's degree and $1,386 among those with an advanced (postbaccalaureate) college degree. Earnings premiums relative to high school graduates were nearly 65 percent among bachelor's degree holders and almost 108 percent among advanced-degree holders.[8]

The earnings advantage associated with higher levels of educational attainment has been rising over time. Analysis of U.S. Census Bureau public-use microdata files from the Current Population Survey reveals a sharp rise in the earnings of young college graduates relative to high school graduates with no postsecondary schooling. During the second half of the 1970s, the size of the college earnings advantage began to rise from under 20 percent in the early part of the decade and continued to increase through the 1980s, reaching 52 percent in 1990 and 70 percent by 2000. After the turn of the century, the rise in the earnings advantage of young college graduates slowed down as the dot-com recession had a substantial adverse impact on young college graduates and the housing boom created a strong demand for high school graduates in blue-collar occupations. But the earnings advantage of young college graduates rose again, reaching about 74 percent in 2015, that is, for every $1 earned by young high school graduates without any postsecondary education, their counterparts with a bachelor's degree earned $1.74.[9]

The response to the rising labor market returns to education has been, up to this point, an increase in the level of education of the population. The educational attainment of the population has been rising steadily, particularly at the high school graduation and bachelor's degree levels. In 2015, 88 percent of the adult (25 and over) population in the United States had completed a high school education or higher and one-third had earned a bachelor's degree or higher.[10] Education attainment levels are also rising among the nation's youth. The White House announced that the high school graduation rate had reached an all-time high during the 2014-2015 school year of 83 percent.[11] Moreover, the college enrollment rate remained at a near record level in the fall of 2015, with nearly 70 percent of recent high school graduates enrolled in college immediately after graduating.[12]

While educational attainment has risen over time, measures of reading, writing, and math proficiencies of young people paint a less rosy picture of human capital acquisition in the United States. Indeed, the National Assessment of Educational Progress (NAEP) measure of the basic skills of youth is worrisome. The most recent NAEP tests of a cross section of American students reveal a decline in the score of 12th graders on the math test between 2013 and 2015. The reading score of 12th graders remained unchanged between 2013 and 2015 but declined between 1992 and 2015.[13]

Worrisome developments about basic skills proficiencies are not limited to high school students. Educational Testing Service analysis of the Survey of Adult Skills of the Programme for the International Assessment of Adult Competencies (PIAAC) test scores found that American millennials scored lower than their counterparts in 15 countries (out of 22) on the literacy test and had the lowest scores among all nations in numeracy skills. The study found similarly disappointing performance among teens and young adults in the United States; American 16- to 24-year-olds beat just two countries on the literacy test and had the lowest mean score on the numeracy test compared to all 22 nations included in the study.[14]

Despite these conflicting signals about trends in educational attainment and skills achievement, increased levels of education are still very closely connected with positive labor market outcomes and remain a good measure of the human capital and productive capacity of workers. But literacy and numeracy skills are also critical and are inextricably related to educational attainment, with academic achievement at the elementary and secondary level exerting a powerful influence on postsecondary enrollment, retention, and completion.

Our analysis of PIAAC data in this report finds large and statistically significant earnings advantages to skills even after accounting for the impact of educational attainment. In other words, among full-time employed workers ages 25 to 54 (a group commonly referred to as prime-age workers) in the United States with identical levels of educational attainment and similar personal characteristics, those with stronger literacy and numeracy proficiencies have higher earnings than counterparts

with weaker literacy and numeracy proficiencies. These findings indicate that basic skills development is not only fundamental to achieving educational attainment advantages but is also directly rewarded by employers in the form of higher earnings. However, those benefits for prime-age, full-time workers seem to accrue only at the bachelor's degree level. Even those who attend some college or even earn a certificate do not reap the earnings rewards.

A Word about the Data

PIAAC was designed to measure adult proficiencies in three key information processing skills —literacy, numeracy, and problem-solving in technology rich environments. The Survey of Adult Skills (PIAAC) was administered in 33 nations during the 2011-2014 period. PIAAC data for the United States that are used in this study are limited to the household portion that was conducted during 2011-2012 among a sample of the 16- to 65-year-old noninstitutional population as well as a supplemental survey conducted during 2013-2014 that was targeted to sample teens and young adults, unemployed adults, and older workers. The combined samples, also referred to as the enhanced U.S. household sample data, include about 8,700 persons between the ages of 16 and 74 who lived in households at the time of the survey.

The PIAAC survey instrument was composed of a background questionnaire as well as cognitive assessments of literacy and numeracy of respondents. PIAAC defines literacy as "understanding, evaluating, using and engaging with written text…" and numeracy as "the ability to access, use, interpret and communicate mathematical information and ideas…"[15] The PIAAC data collection process limits the time and related burdens required of respondents by only administering a fraction of the proficiency tests to individual adult participants in the survey. PIAAC survey respondents were not administered every skill proficiency question. Instead, 10 plausible values (PVs) for literacy and numeracy test scores are provided in the PIAAC data file. PVs are a statistical means to replicate a probable score distribution that summarizes how well each respondent answered a small subset of the assessment items and how well other respondents from a similar background performed on the rest of the assessment item pool. These plausible values are estimated using item response theory models.[16]

According to the PIAAC technical documentation, in addition to the estimation of survey errors from the complex sampling design of PIAAC, one should also estimate the measurement errors presented in the proficiency assessments whenever the 10 plausible scores are used in the analysis. The measurement error accounts for variations in these 10 plausible values. All of the PIAAC proficiency measures in this report—for both descriptive and regression-based estimates and associated measurement errors—are estimated using 10 plausible values.

We begin the report with a descriptive analysis of the monthly earnings of full-time employed 25- to 54-year-old workers in 2012-2014, which are part of the enhanced U.S. household sample data, by their literacy proficiencies, educational attainment, and a wide array of demographic traits. Mean monthly earnings are examined for several demographic and educational subgroups of workers, and for each subgroup we present a separate analysis of their mean monthly earnings by the level of their literacy and numeracy proficiencies. The central focus of the analysis in this report is the connection between earnings and the human capital of workers measured by their educational attainment and literacy and numeracy proficiencies.

The descriptive analysis is followed by multivariate regression analysis of the monthly earnings of 25- to 54-year-old full-time employed workers. Using human capital earnings functions, these regression models estimate the independent effect of literacy and numeracy proficiencies and the educational attainment of U.S. workers on their monthly earnings by statistically holding constant the effect on earnings of all the other independent variables included in the regression model. Earnings are found to vary by education, skills, paid work experience, intensity of employment (hours per week), economic sector of employment, region, and demographic traits of workers. By including these worker traits as explanatory variables, these multivariate regression models are designed to estimate the independent effect of each of these variables on the monthly earnings of workers.

Descriptive Analysis of Earnings: Mean Monthly Earnings by Proficiencies, Education, and Demographic Traits of Workers

This section of the report provides a descriptive portrait of mean monthly earnings during 2012-2014 among prime age, full-time workers who were part of the enhanced U.S. household sample data. We begin with an examination of the relationship between mean monthly earnings of all workers and their levels of literacy and numeracy achievement as measured by the PIAAC literacy and numeracy test scores. We examine mean monthly earnings of workers in the following four achievement levels of literacy and numeracy proficiencies:

- level 1 or below (score of 225 or less)
- level 2 (226 to 275)
- level 3 (276 to 325)
- levels 4 and 5 combined (326 to 500)

The differences in earnings by literacy and numeracy proficiencies are presented as mean earnings of workers in each of the four achievement levels relative to the mean earnings of workers in level 2. Examinations of the earnings of workers by their achievement level of literacy and numeracy proficiencies are presented for all 25- to 54-year-old full-time workers, and separately for subgroups of workers by their educational attainment.

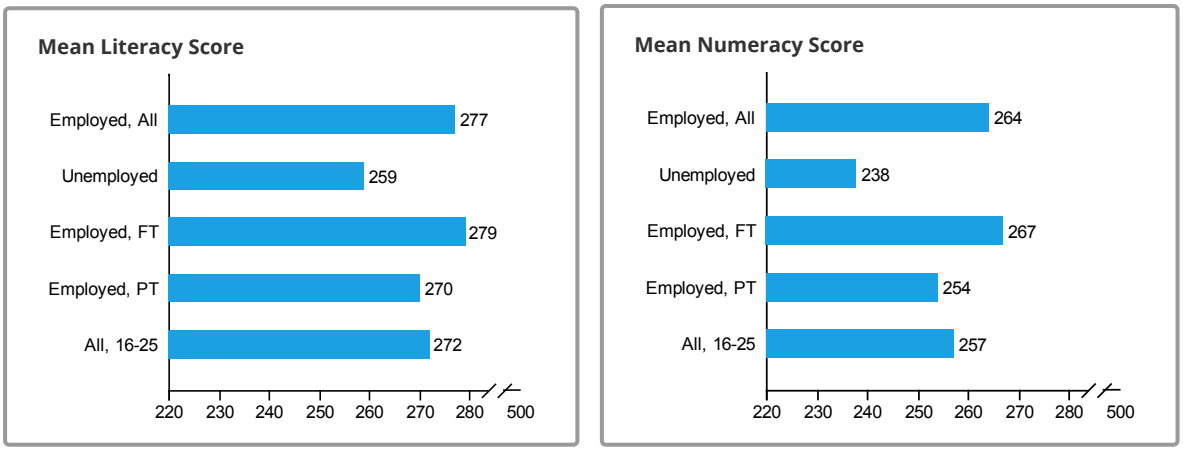
More detailed analysis of the monthly earnings among subgroups of workers is presented in Appendix C of this report. This analysis includes average monthly earnings estimates by the four levels of literacy and numeracy proficiency listed above for subgroups of workers by educational attainment, gender, age, race-ethnicity, work experience, nativity status, self-reported English writing ability, disability, sector of work, region of residence, and skill-based occupational groups.

Literacy and Numeracy Proficiencies of Workers

A comparison by the National Center for Education Statistics (NCES) of the literacy and numeracy skills of U.S. adults and their counterparts in 21 other developed nations around the world indicates that the skills of U.S. adults are middling at best. Among all 16- to 65-year-old adults in the United States, the mean score on the PIAAC literacy scale was 272—significantly lower than average scores in 7 countries, higher than in 6 , and not statistically different from 8 countries and the overall PIAAC international average. The mean U.S. score of 257 on the numeracy scale was at the lower end of the international comparison of adult math proficiency. The U.S. mean numeracy score was significantly lower than the average score of 16 countries and the PIAAC international average, higher than in 3 countries, and not statistically different from the mean score of 2.[17]

An examination of the literacy and numeracy proficiencies of 25- to 54-year-old full-time employed workers studied in this report reveals that their mean scores were higher than those of all 16- to 65-year-old adults in the United States: 281 versus 272 on the PIAAC literacy assessment, and 269 versus 257 on the PIAAC numeracy assessment. These differences are expected since the average skills scores of employed working-age adults ages 16 to 65 are higher than those who are unemployed (277 versus 259 on the literacy assessment, and 264 versus 238 on numeracy), and full-time employed adults have higher skill scores than their part-time employed counterparts (279 versus 270 on literacy, and 267 versus 254 on numeracy) (Figure 1). Conversely, adults with higher skills are more likely to be employed overall and in full-time positions.[18]

Figure 1: Mean Literacy and Numeracy Proficiency Scores of 16- to 65-Year-Olds by Employment and Full-Time/Part-Time Employment Status, 2012-2014



The literacy and numeracy proficiencies of workers reported next are presented in the form of mean scores and levels of proficiencies. Proficiency levels based on a range of cut scores are associated with a range of literacy and numeracy tasks. The proficiency levels, score ranges, and task descriptions for each level are presented in Table 1 (literacy) and Table 2 (numeracy).

Table 1: PIAAC Literacy Proficiency Levels and Cut Scores and Task Descriptions for each Literacy Proficiency Level

LITERACY PROFICIENCY LEVELS AND CUT SCORES	LITERACY TASK DESCRIPTIONS
LEVEL 5 (376 – 500)	At this level, tasks may require the respondent to search for and integrate information across multiple, dense texts; construct syntheses of similar and contrasting ideas or points of view; or evaluate evidence-based arguments. Application and evaluation of logical and conceptual models of ideas may be required to accomplish tasks. Evaluating reliability of evidentiary sources and selecting key information is frequently a requirement. Tasks often require respondents to be aware of subtle, rhetorical cues and to make high-level inferences or use specialized background knowledge.
LEVEL 4 (326 – 375)	Tasks at this level often require respondents to perform multiple-step operations to integrate, interpret, or synthesize information from complex or lengthy continuous, noncontinuous, mixed, or multiple type texts. Complex inferences and application of background knowledge may be needed to perform the task successfully. Many tasks require identifying and understanding one or more specific, noncentral idea(s) in the text in order to interpret or evaluate subtle evidence-claim or persuasive discourse relationships. Conditional information is frequently present in tasks at this level and must be taken into consideration by the respondent. Competing information is present and sometimes seemingly as prominent as correct information.
LEVEL 3 (276 – 325)	Texts at this level are often dense or lengthy, and include continuous, noncontinuous, mixed, or multiple pages of text. Understanding text and rhetorical structures become more central to successfully completing tasks, especially navigating complex digital texts. Tasks require the respondent to identify, interpret, or evaluate one or more pieces of information, and often require varying levels of inference. Many tasks require the respondent to construct meaning across larger chunks of text or perform multistep operations in order to identify and formulate responses. Often tasks also demand that the respondent disregard irrelevant or inappropriate content to answer accurately. Competing information is often present, but it is not more prominent than the correct information.
LEVEL 2 (226 – 275)	At this level, the medium of texts may be digital or printed, and texts may comprise continuous, noncontinuous, or mixed types. Tasks at this level require respondents to make matches between the text and information, and may require paraphrasing or low-level inferences. Some competing pieces of information may be present. Some tasks require the respondent to cycle through or integrate two or more pieces of information based on criteria; compare and contrast or reason about information requested in the question; navigate within digital texts to access and identify information from various parts of a document.
LEVEL 1 (176 – 225)	Most of the tasks at this level require the respondent to read relatively short digital or print continuous, noncontinuous, or mixed texts to locate a single piece of information that is identical to or synonymous with the information given in the question or directive. Some tasks, such as those involving noncontinuous texts, may require the respondent to enter personal information onto a document. Little, if any, competing information is present. Some tasks may require simple cycling through more than one piece of information. Knowledge and skill in recognizing basic vocabulary, determining the meaning of sentences, and reading paragraphs of text is expected.
BELOW LEVEL 1 (0 – 175)	The tasks at this level require the respondent to read brief texts on familiar topics to locate a single piece of specific information. There is seldom any competing information in the text and the requested information is identical in form to information in the question or directive. The respondent may be required to locate information in short continuous texts. However, in this case, the information can be located as if the text were noncontinuous in format. Only basic vocabulary knowledge is required, and the reader is not required to understand the structure of sentences or paragraphs or make use of other text features. Tasks below level 1 do not make use of any features specific to digital texts.

Source: U.S. Department of Education, National Center for Educational Statistics, Institute of Education Sciences, *Skills of U.S. Unemployed, Young, and Older Adults in Sharper Focus: Results from the Program for the International Assessment of Adult Competencies (PIAAC) 2012/2014, First Look,* March 2016, Exhibit B-1, Page B-3, https://nces.ed.gov/pubs2016/2016039rev.pdf (PDF).

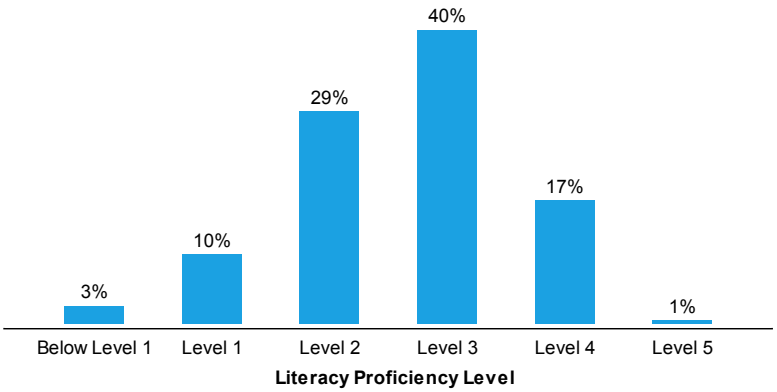
Table 2: PIAAC Numeracy Proficiency Levels and Cut Scores and Task Descriptions for each Numeracy Proficiency Level

NUMERACY PROFICIENCY LEVELS AND CUT SCORES	NUMERACY TASK DESCRIPTIONS
LEVEL 5 (376 – 500)	Tasks at this level require the respondent to understand complex representations and abstract and formal mathematical and statistical ideas, possibly embedded in complex texts. Respondents may have to integrate multiple types of mathematical information where considerable translation or interpretation is required; draw inferences; develop or work with mathematical arguments or models; and justify, evaluate and critically reflect upon solutions or choices.
LEVEL 4 (326 – 375)	Tasks at this level require the respondent to understand a broad range of mathematical information that may be complex, abstract or embedded in unfamiliar contexts. These tasks involve undertaking multiple steps and choosing relevant problem-solving strategies and processes. Tasks tend to require analysis and more complex reasoning about quantities and data; statistics and chance; spatial relationships; and change, proportions and formulas. Tasks at this level may also require understanding arguments or communicating well-reasoned explanations for answers or choices.
LEVEL 3 (276 – 325)	Tasks at this level require the respondent to understand mathematical information that may be less explicit, embedded in contexts that are not always familiar and represented in more complex ways. Tasks require several steps and may involve the choice of problem-solving strategies and relevant processes. Tasks tend to require the application of number sense and spatial sense; recognizing and working with mathematical relationships, patterns, and proportions expressed in verbal or numerical form; and interpretation and basic analysis of data and statistics in texts, tables and graphs.
LEVEL 2 (226 – 275)	Tasks at this level require the respondent to identify and act on mathematical information and ideas embedded in a range of common contexts where the mathematical content is fairly explicit or visual with relatively few distractors. Tasks tend to require the application of two or more steps or processes involving calculation with whole numbers and common decimals, percentages and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.
LEVEL 1 (176 – 225)	Tasks at this level require the respondent to carry out basic mathematical processes in common, concrete contexts where the mathematical content is explicit with little text and minimal distractors. Tasks usually require one-step or simple processes involving counting, sorting, performing basic arithmetic operations, understanding simple percentages such as 50%, and locating and identifying elements of simple or common graphical or spatial representations.
BELOW LEVEL 1 (0 – 175)	Tasks at this level require the respondents to carry out simple processes such as counting, sorting, performing basic arithmetic operations with whole numbers or money, or recognizing common spatial representations in concrete, familiar contexts where the mathematical content is explicit with little or no text or distractors.

Source: U.S. Department of Education, National Center for Educational Statistics, Institute of Education Sciences, *Skills of U.S. Unemployed, Young, and Older Adults in Sharper Focus: Results from the Program for the International Assessment of Adult Competencies (PIAAC) 2012/2014, First Look,* March 2016, Exhibit B-3, Page B-7, https://nces.ed.gov/pubs2016/2016039rev.pdf (PDF).

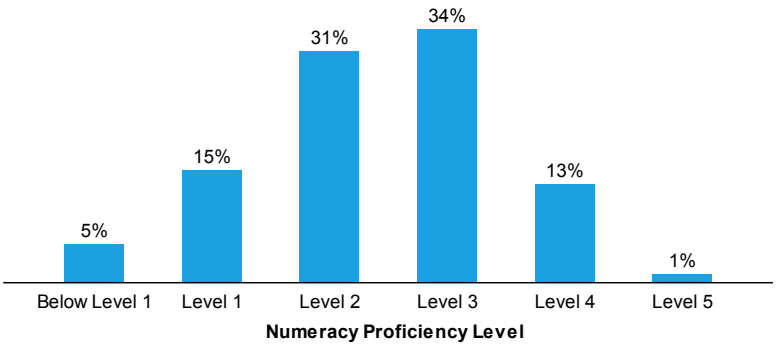
The percentage distribution of 25- to 54-year-old full-time employed workers across six PIAAC literacy and numeracy proficiency levels presented in figures 2 and 3 find that the bulk of these workers had proficiencies in the middle two levels, with much smaller shares at the two ends.[19] Distribution by literacy proficiency levels in Figure 2 finds only 3 percent of workers scored below literacy proficiency level 1 and an additional 10 percent of workers scored at literacy level 1, resulting in a combined 13 percent scoring at or below literacy proficiency level 1. The middle two levels accounted for 69 percent of these workers (29 percent in level 2 and 40 percent in level 3). The share of workers who scored in level 4 of the literacy proficiency test was 17 percent and in level 5 was only 1 percent (Figure 2).

Figure 2: Percentage Distribution of 25- to 54-Year-Old Full-Time Employed Workers by Literacy Proficiency Level, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Figure 3: Percentage Distribution of 25- to 54-Year-Old Full-Time Employed Workers by Numeracy Proficiency Level, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

On the numeracy scale, one-fifth of 25- to 54-year-old full-time employed workers fell in the two lowest proficiency levels: 5 percent below level 1, and 15 percent at level 1 (Figure 3). About two-thirds of workers had numeracy scores that placed them in levels 2 or 3 of the numeracy proficiency test. Only 14 percent of workers scored in levels 4 and 5 (13 percent in level 4 and 1 percent in level 5). Because of the small number of observations at the two ends of the literacy and numeracy proficiency distribution, our examination of outcomes by literacy and numeracy proficiency levels combines the two lowest levels (below level 1 and level 1) and the two highest levels (levels 4 and 5), in line with standard practice for PIAAC skill measures.

A large and convincing body of evidence has found that the employment and earnings outcomes of labor market participants (and even the likelihood of participating in the labor market) are strongly associated with the acquisition of human capital. Workers with more intensive development of their productive potential in the form of higher levels of educational attainment and greater work experience are more knowledgeable and able to perform more sophisticated tasks on the job.

The standard indicator used as proxy measure for human capital is the level of educational attainment primarily because of its widespread use in household surveys. Indeed, educators from high school principals and school district superintendents to college deans and presidents, not to mention a plethora of elected officials and business leaders, point to Census data that illustrate the earnings advantages associated with higher levels of educational attainment. The higher productive abilities of workers with higher levels of educational attainment, which presumably represent stronger literacy and numeracy proficiencies, translates into improved employment and earnings outcomes in U.S. labor markets.

Our analysis of PIAAC data for prime-age, full-time employed workers also indicates that the mean monthly earnings of American workers are closely related to their literacy and numeracy proficiencies. The mean monthly earnings of full-time employed 25- to 54-year-old workers increased sharply with higher levels of literacy and numeracy skills. In 2012-2014, monthly earnings were $2,940 among those with literacy proficiency at or below level 1, rising to $3,800 and $5,070 per month for those in levels 2 and 3, respectively, with another sharp rise to $6,700 per month for workers with scores that placed them in levels 4 and 5 combined.

The sizes of earnings advantages associated with higher levels of literacy skills are large. In comparison to the mean monthly earnings of workers in level 2, workers with literacy proficiencies in level 1 or below earned 23 percent less, while workers with level 3 literacy proficiencies earned 33 percent more, and those in levels 4 and 5 combined earned 77 percent more (Table 3). The gap between the mean earnings of workers in the highest (level 4/5) and lowest (1 or below) levels of literacy proficiency was $3,800 ($6,717 versus $2,939, representing a relative earnings advantage of 128 percent). In other words, for every $1 earned by workers with the lowest level of literacy proficiency, their counterparts with the highest literacy proficiency levels earned $2.28.

Table 3: Mean Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers by Literacy and Numeracy Proficiency Levels, 2012-2014 (Standard Errors in Parentheses)

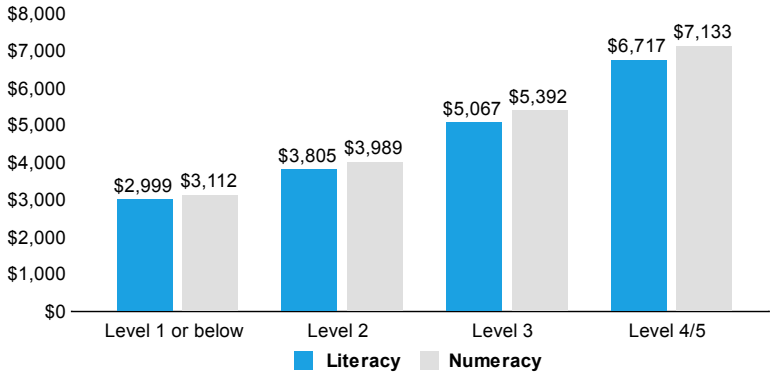
PROFICIENCY LEVEL	MEAN MONTHLY EARNINGS	MONTHLY EARNINGS COMPARED TO LEVEL 2
ALL	$4,729 (109)	
LITERACY PROFICIENCY LEVELS		
LEVEL 1 OR BELOW	$2,939 (210)	0.77***
LEVEL 2	$3,805 (169)	1.00
LEVEL 3	$5,067 (166)	1.33***
LEVEL 4/5	$6,717 (293)	1.77***
NUMERACY PROFICIENCY LEVELS		
LEVEL 1 OR BELOW	$3,112 (183)	0.78***
LEVEL 2	$3,989 (155)	1.00
LEVEL 3	$5,392 (187)	1.35***
LEVEL 4/5	$7,133 (445)	1.79***

Statistical significance: *** sig. at .01 level.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Earnings of workers were also closely and positively related to their numeracy proficiencies. Gaps between the mean monthly earnings of prime-age, full-time employed workers with different levels of numeracy skill were quite sizable. The earnings of workers (relative to those with level 2 numeracy proficiency) were 22 percent lower among those with numeracy proficiency at or below level 1, 35 percent higher among those scoring in level 3, and 79 percent higher among those with scores placing them in levels 4 or 5 (Table 3).

With mean monthly earnings of $7,133 among full-time workers with the strongest numeracy skills and just $3,112 among those with the weakest numeracy skills, the gap between the earnings of workers with the highest and lowest numeracy proficiency was also very large: $4,021 per month, representing an earnings advantage of 129 percent for workers with the highest levels of numeracy proficiency relative to their counterparts with the lowest level of numeracy proficiency, about the same in relative terms as the gap between the earnings of workers with the highest and lowest levels of literacy proficiency (Figure 4).

Figure 4: Mean Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers by Literacy and Numeracy Proficiency Levels, 2012-2014



Note: Figures in U.S. dollars
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Educational Attainment and Literacy and Numeracy Proficiencies

Formal education is the most readily available measure of the human capital of individuals. Human capital represents the skills, abilities, knowledge, and work experience of individuals. Attaining formal education adds to their stock of human capital.

Although education is readily available, it is not a complete measure of human capital because it only serves, along with other mechanisms, as an important *channel* through which human capital traits are developed. A fundamental role of schooling is to increase some of the most important personal characteristics valued by employers, especially basic skills and occupational knowledge. The influence of formal schooling on literacy and numeracy proficiencies and labor market outcomes works through two distinct channels. First, since student literacy and numeracy skills at lower grades influence the likelihood that students will attain higher levels of educational attainment, the likelihood of students dropping out of high school is closely connected.[20] Second, the likelihood of postsecondary enrollment, persistence, and completion are also closely related to high school students' scores on basic skills measures.[21] It thus comes as no surprise that basic skills scores and levels of educational attainment are closely connected.

The likelihood of further education is closely connected to the present level of basic skills of students. College enrollment of graduating high school students is heavily influenced by students' basic skill development as measured by standardized test scores as well as student grade point average in high school. Indeed, both of these measures are powerful predictors of the likelihood of college enrollment, retention, and completion.[22] Young people who fail to develop solid basic skill proficiencies by the secondary school level have only a remote chance of achieving further education beyond high school. Indeed, earning a high school diploma itself is associated with the development of reading, writing, and math skills. The likelihood of an entering ninth grader completing high school is related to his or her level of basic skills as measured by standardized test scores and grade point average.[23] Measures of math and English language proficiency at the middle school level are also thought to be important predictors of the risk of dropping out of high school.[24]

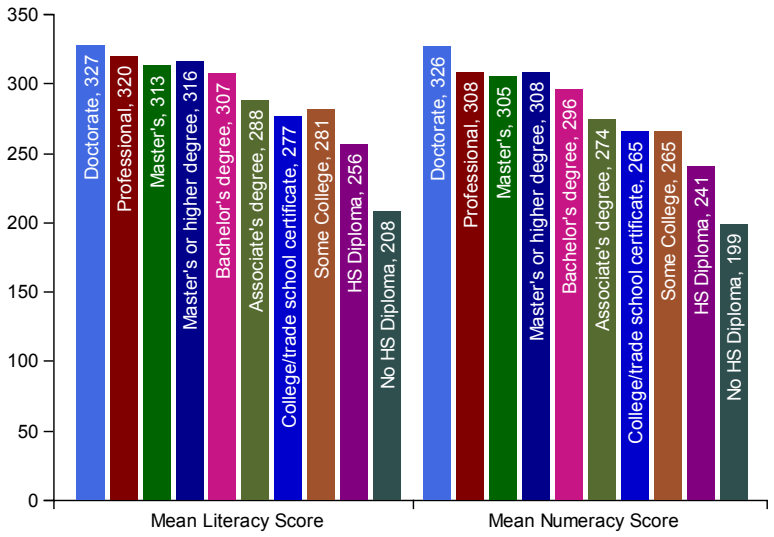
Mean scores on the PIAAC literacy and numeracy proficiencies of prime-age, full-time employed U.S. workers included in our analysis reveal a close positive association between both literacy and numeracy scores and the highest level of educational attainment of these workers (Figure 5). The mean literacy score of 25- to 54-year-old full-time employed high school dropouts was just 208, a score that placed them at level 1. The mean score of 256 among high school graduates with full-time jobs fell within level 2 score range. Mean literacy scores of 288, 307, and 316 among workers with associate's, bachelor's, and master's or higher degrees, respectively, placed the average literacy proficiency of these three groups of full-time employed college graduates in level 3. The difference between the mean literacy proficiency score of workers without a high school diploma and those with a master's degree or higher was sizable: 108 points.

Among workers with graduate level college degrees, the mean literacy proficiency scores were 313, 320, and 327 for workers with master's, professional, and doctorate degrees, respectively. Only the doctorate degree group of prime-age, full-time employed workers had a mean score that placed them within the literacy score range that defines level 4.

The mean numeracy proficiency scores among educational groups of these workers also exhibited a strong positive connection with their level of education. Mean numeracy scores among prime-age, full-time workers increased from 199 among high school dropouts and 241 among high school graduates to 274 among workers with an associate's degree, and 296 and 308 among those with bachelor's and master's or higher degrees, respectively, yielding a yawning gap between the mean numeracy score of workers with the lowest and highest level of education (high school dropouts and

master's degree or higher) of 109 points. Workers with graduate degrees (master's, professional, and doctorate degrees) had higher scores on the numeracy proficiency scale: 305, 308, and 326, respectively.

Figure 5: Mean Literacy and Numeracy Proficiency Scores of 25- to 54-Year-Old Full-Time Employed Workers by Educational Attainment, 2012-2014

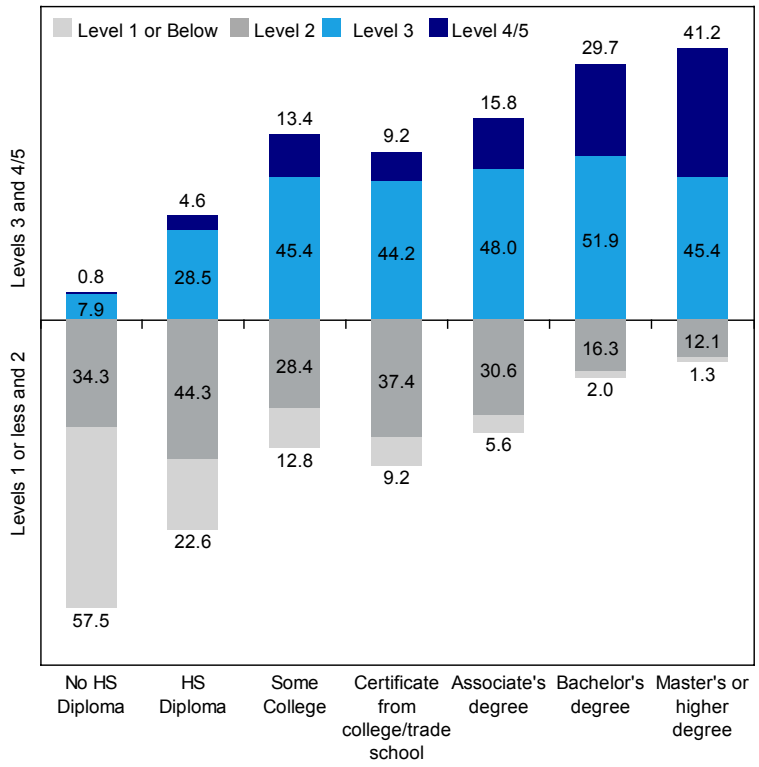


Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

While there is a clear positive connection between mean basic skill scores and the level of education, we also found considerable variation in literacy and numeracy scores among workers with the same level of educational attainment. Earning a high school or college credential is not necessarily a signal of basic skills achievement. Indeed, we find that about 9 percent of prime-age, full-time employed high school dropouts scored in higher literacy and numeracy levels than 18 percent of their counterparts who earned a bachelor's degree and, even more surprising, higher than 13 percent of those who earned an advanced degree.

A closer look at the distribution of 25- to 54-year-old full-time employed workers in each educational group by the level of their literacy and numeracy proficiencies can be found in figures 6 and 7. The concentration of workers in literacy proficiency level 1 or below and levels 4/5 varied sharply by educational attainment. Workers with literacy proficiency scores at or below level 1 accounted for 58 percent of high school dropouts and 23 percent of high school graduates, but fewer than 6 percent among college graduates with an associate's degree and 2 percent or less among those with a bachelor's or higher degree. Workers with literacy proficiency scores in levels 4 or 5 comprised much lower shares of those without a college degree than those with a college degree. Fewer than 5 percent of high school graduates and less than 1 percent of high school dropouts had literacy proficiency scores in level 4/5, compared to 13 percent among those who had completed some college without a credential, 9 percent among workers with a college/trade school certificate, and 16, 30, and 41 percent among those with associate's, bachelor's, and master's or higher degrees, respectively.

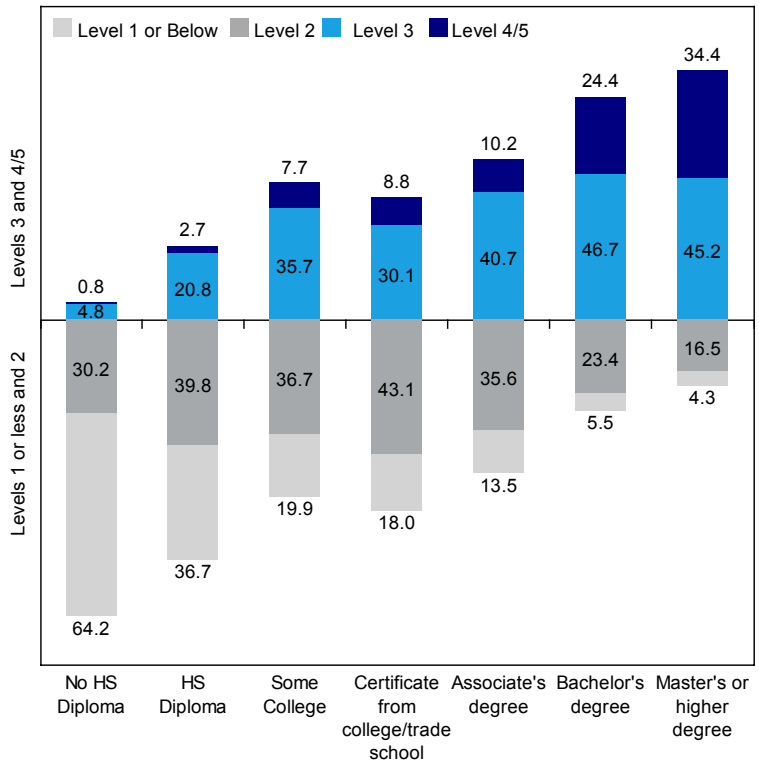
Figure 6: Percentage Distribution of 25- to 54-Year-Old Full-Time Employed Workers by Literacy Proficiency Level, by Educational Attainment, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

The results for numeracy proficiency were similar to the results for literacy proficiency. The share of workers with high levels of numeracy proficiency (levels 4/5) rose with education from just less than 1 percent among high school dropouts and 3 percent among high school graduates to 10, 24, and 34 percent among workers with associate's, bachelor's, and master's or higher degrees, respectively. Workers with numeracy proficiency scores at or below level 1 comprised 64 percent of high school dropouts and 37 percent of high school graduates and progressively smaller shares of workers with higher levels of education (Figure 7).

Figure 7: Percentage Distribution of 25- to 54-Year-Old Full-Time Employed Workers by Numeracy Proficiency Level, by Educational Attainment, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Although workers with a college degree were very unlikely to score at or below level 1 of the literacy and numeracy proficiency scales, sizable shares of college-educated prime-age, full-time employed workers had literacy and numeracy skills below level 3, which is considered a minimum standard for literacy and numeracy proficiencies associated with more positive economic, social, and educational outcomes.[25] Level 3 skills are more sophisticated and require the ability to integrate different sources of information and solve complex problems. Over 13 percent of 25- to 54-year-old full-time employed U.S. workers with a master's or higher degree scored at level 1 or 2 on the PIAAC literacy proficiency test. This ratio was 18 percent among workers with a bachelor's degree and 36 percent among those with an associate's degree. For workers with a college/trade school certificate, the ratio was 47 percent. It was 41 percent for those with some college without earning a credential, while two-thirds of high school graduates and over 90 percent of high school dropouts had literacy proficiency scores below level 3 (Figure 6).

The results on the numeracy scale reveal that one-fifth of prime-age, full-time workers with a master's or higher degree had a numeracy skill score below level 3. Nearly 30 percent among those with a bachelor's degree and nearly one-half among workers with an associate's degree had sub-level 3 numeracy scores (Figure 7).

So even though *average* proficiencies of workers increase with their level of education, these findings reveal that *there is a sizable variation in the level of skills of workers with the same level of educational attainment.* We find this variation in basic skill proficiencies particularly pronounced among better educated workers with college credentials. It follows that we expect earnings of workers to vary by not only the level of educational attainment, itself a measure of human capital, but also by the level of literacy and numeracy skills within educational groups. In fact, our analysis of the level of skills within educational subgroups of prime-age, full-time employed workers reveal the existence of surprisingly large shares of college graduates who have achieved the level of literacy and numeracy proficiencies that studies have found to be *below skill score levels* thought to be associated with positive economic, educational, and social outcomes.[26]

In the human capital measurement framework, education is defined with a standard measure —years of schooling completed and the level of credentials earned—yet it is quite clear that education is far from a standardized product. Not all education is created equal. The quality of education at each level of attainment is highly varied with respect to the basic skills development of students, their acquisition of occupational knowledge, social skills, and fundamental character traits, and, therefore, their future labor market outcomes.

To understand that not all education is the same, one needs only to look at standardized test scores across different public schools in the same school district. For example, an examination of standardized scores of public high school students in Philadelphia found that two public high schools in the city are ranked among the top five high schools in the state of Pennsylvania in basic skill scoring; a total of 5 high schools in the city are ranked in the top decile of all high schools in the state, accounting for about 6 percent of public high school enrollment in the city. In contrast, 22 public high schools in the city are ranked in the bottom 10 percent of Pennsylvania high schools; these schools account for 45 percent of all public high school students in the city.[27]

At the postsecondary level, long-term employment and earnings experiences of bachelor's degree holders with no additional schooling are closely connected to their undergraduate field of study and vary quite sharply by major field.[28] College credentials are awarded by thousands of institutions of higher learning across numerous fields of study. The variation in the quality of education provided by institutions of higher learning partly underlies the variation in skills and knowledge within groups with the same level of education. While individual skills vary among those with the same level of education, it is also very likely that individual skills vary, albeit not as widely, among individuals with the same level of education from the same institution and even the same field of study. This suggests that the strength of the link between education and earnings (and other labor market outcomes) is contingent upon, among other factors, the quality of the education provided and the choice of field of study at the college and university level.

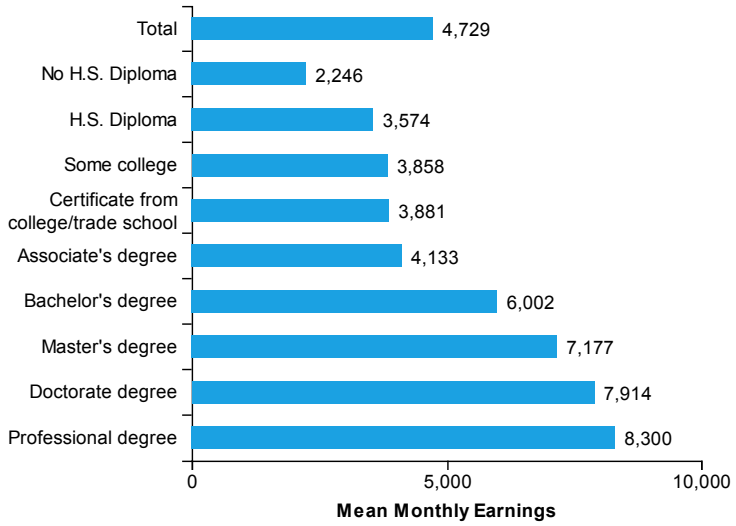
Education and Earnings

In this section of the report, we examine the mean monthly earnings of 25- to 54-year-old full-time employed workers by educational attainment in an effort to measure the direct labor market impact of literacy and numeracy skills among those with the same level of education. As postulated by human capital theory, our findings from the PIAAC data files reveal that earnings do indeed rise sharply with educational attainment. The average monthly earnings overall were $4,729, amounting on an annualized basis to about $57,000 during the 2012-2014 period. Workers without a high school diploma earned just about $2,250 per month despite full-time employment (Figure 8). Those with a high school diploma, but no college, had mean monthly earnings of $3,574, a level that is nearly $1,330, or 59 percent, higher than the earnings of counterparts who failed to complete high school.

The mean monthly earnings of workers who completed some postsecondary education without earning a certificate or degree were not significantly different from those of workers with just a high school diploma ($3,858 versus $3,574 for high school graduates). It was likewise for attaining a college or trade school certificate ($3,881 versus $3,574);[29] the associated earnings premium was a small $307 per month, or 8 percent, compared to high school graduates and was not statistically significant.

Recent evidence has shown that workers with certifications earned more than those without them.[30] In a separate analysis of the earnings among 16- to 65-year-old employed (full-time and part-time) workers (not just those of prime age), we found no difference between the earnings of workers with some college but no degree or certificate award and those of high school graduates. However, the same analysis found a much more significant 12 percent earnings premium among workers with a college certificate relative to those with some college without a degree or certificate. Earning a certificate award from a college or trade school is associated with a labor market reward relative to completing some college without earning a degree or certificate among the entire population of 16- to 65-year-old workers but not among prime working-age (25 to 54-year-old), full-time employed workers. Thus, further research on the sources of the earnings premiums of workers with certificates employed in the labor market "periphery," which includes younger and older workers and prime-age, part-time employed workers, is warranted given that the pace of certification awards at the postsecondary level has accelerated in recent years. Examining only the prime-age, full-time labor market segment excludes 40 percent of the workforce.[31]

Figure 8: Mean Monthly Earnings of 25- to 54-Year-Old Full-Time Workers by Educational Attainment, 2012-2014



Note: Figures in U.S. dollars
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors. Figures in U.S. dollars.

Workers with an associate's degree earned an average of $4,130 per month, yielding a monthly earnings premium of nearly 16 percent relative to those with a high school diploma. Workers with a bachelor's degree earned substantially more per month. With a mean monthly salary of $6,000, workers with a bachelor's degree earned nearly $1,900, or 45 percent, more than workers with just an associate's degree. Earnings of workers continued to increase with higher level college credentials: rising to $7,200 per month among those with a master's degree, representing $1,200, or nearly 20 percent, more than the monthly earnings of workers with just a bachelor's degree; $7,900 per month for general doctorate degree holders, yielding a premium of $740 per month, or 10 percent, relative to those with a master's degree; and $8,300 among workers with a professional degree such as M.D., D.M.D., J.D., and so on.[32] (Table 4 describes relative differences).

Table 4: Difference and Statistical Significance of the Difference between Mean Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers by Educational Attainment, 2012-2014

DIFFERENCE BETWEEN MEAN EARNINGS OF EDUCATIONAL GROUPS (EARNINGS OF GROUPS IN COLUMNS B-H MINUS EARNINGS OF GROUPS IN COLUMN A)							
(A) EDUCATIONAL ATTAINMENT	(B) NO H.S. DIPLOMA	(C) H.S. DIPLOMA	(D) SOME COLLEGE	(E) CERTIFICATE	(F) ASSOCIATE'S DEGREE	(G) BACHELOR'S DEGREE	(H) MASTER'S OR HIGHER DEGREE
NO H.S. DIPLOMA	0	1,328***	1,612***	1,634***	1,887***	3,756***	5,206***
H.S. DIPLOMA	-1,328***	0	284	307	559***	2,428***	3,878***
SOME COLLEGE	-1,612***	-284	0	23	275	2,144***	3,594***
CERTIFICATE	-1,634***	-307	-23	0	252	2,121***	3,572***
ASSOCIATE'S DEGREE	-1,887***	-559***	-275	-252	0	1,869***	3,319***
BACHELOR'S DEGREE	-3,756***	-2,428***	-2,144***	-2,121***	-1,869***	0	1,450***
MASTER'S OR HIGHER DEGREE	-5,206***	-3,878***	-3,594***	-3,572***	-3,319***	-1,450***	0

Statistical significance: *** sig. at .01 level.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Educational Attainment and Literacy and Numeracy Proficiencies and Earnings

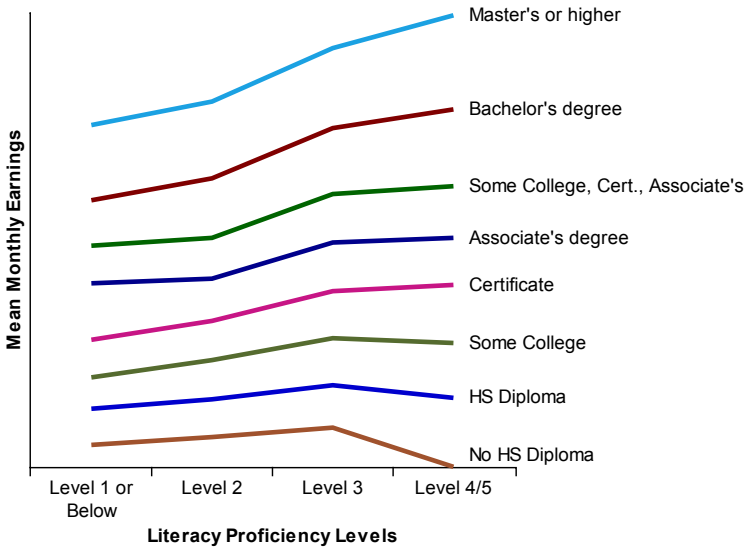
Formal educational attainment represents one measure of human capital and the productive capacity of workers. Literacy and numeracy proficiencies represent a major component of the actual skills that workers supply and employers purchase in the labor market. Our examination of earnings by literacy and numeracy proficiencies presented in a previous section found that workers with higher level proficiencies have sharply higher earnings than those with lower level proficiencies. Our examination of the link between earnings and educational attainment above found that earnings of workers increased with the level of educational attainment. However, we also found sizable variations in the level of literacy and numeracy proficiencies among workers with the *same level of educational attainment*, particularly the surprisingly large share of college-degreed workers with skills below level 3 on the PIAAC scale.

Given the strong link between skills and earnings, these findings raise a question: Do the earnings of workers with the same level of educational attainment vary by the level of their literacy and numeracy proficiencies? We explore this question by examining variations in the monthly earnings of 25- to 54-year-old full-time employed workers within each educational attainment level by their literacy and numeracy proficiencies.[33] The data suggest that the monthly earnings of prime-age, full-time employed workers rise with literacy scores as well as numeracy scores within most educational groups (figures 9 and 10).

These findings provide important insights into the limitations of estimating returns to human capital based exclusively on educational attainment, along with work experience, as the measure of the stock of an individual's human capital. The combination of educational attainment, work experience, and cognitive skills provides a more complete measure of human capital.

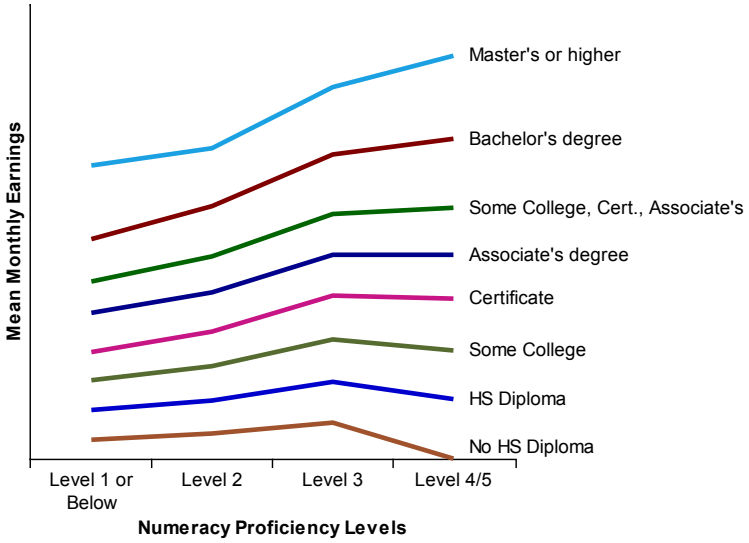
However, because of the widespread availability of educational attainment data and limited availability of measures of cognitive skills in most national household databases, education is frequently used as the only measure of human capital. Large sample surveys such as the decennial U.S. Census and Current Population Surveys (CPS) contain data on background socioeconomic traits, earnings, and educational attainment and are frequently used by researchers to estimate human capital earnings regressions. One of the shortcomings of human capital earnings regression models estimated from these databases is the lack of cognitive skill measures. The result is an exclusive focus on educational attainment with too little attention paid to the acquisition of abilities, knowledge, and skills—traits that are rewarded in the job market. In some instances, this reliance on educational attainment as the measure of human capital may have led to overemphasizing policies designed to increase the level of educational attainment of the population with little regard to developing basic skills in that education process.

Figure 9: Mean Monthly Earnings by Literacy Proficiency Levels of 25- to 54-Year-Old Full-Time Employed Workers in Each Major Educational Group, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Figure 10: Mean Monthly Earnings by Numeracy Proficiency Levels of 25- to 54-Year-Old Full-Time Employed Workers in Each Major Educational Group, 2012-2014



Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

The social and economic consequences of misinterpreting the educational attainment measure and overrepresenting its influence on outcomes can be substantial. Resources that might be better spent on alternative ways to bolster skills such as early education or career and technical education could get short shrift. If the only dimension of human capital that is measured is the quantity of education, then it is not surprising to conclude that the quantity of schooling is central to policies to improve employment and earnings outcomes. Because of the wider availability of the education measure of human capital and less of the skill measure in most large-scale databases, there are considerably fewer studies that utilize measures of skills to estimate the impact of human capital on earnings and other labor market outcomes of workers.

Only few large-scale nationally representative surveys, such as the National Longitudinal Surveys, contain measures of cognitive ability (one measure is the Armed Services Vocational Aptitude Battery score). Yet the evidence is quite clear that cognitive skills are important determinants of labor market outcomes of workers.[34] Both cognitive and noncognitive skills are found to influence a variety of labor market and behavioral outcomes.[35] Research on labor market returns to schooling are frequently based on educational attainment and background traits without cognitive and noncognitive skills due to a lack of reliable and large-scale data.[36]

Availability of skills in national datasets for the adult population began in the early 1990s when the NCES conducted a national household survey of adult literacy—the National Adult Literacy Survey (NALS). Findings from this survey revealed that the literacy proficiencies of workers were positively and strongly associated with their weekly and annual earnings.[37] In 2003, the NCES launched the nationally representative 2003 National Assessment of Adult Literacy (NAAL) survey, which assessed proficiencies of adults aged 16 and older. Labor market findings from this survey were similar to those from NALS; in comparison to adults with higher levels of literacy, adults with low levels of literacy were likely to have considerably lower wages and higher rates of reliance on public assistance.[38] Internationally, in the early 1990s the Organisation for Economic Co-operation and Development (OECD) launched the International Adult Literacy Survey (IALS) in 15 countries. In 2003 and 2006, the OECD launched the Adult Literacy and Lifeskills (ALL) survey with a goal to assess the literacy and numeracy skills of adults that are required in the workplace.

Building upon the framework of these previous surveys, the OECD in 2010 launched the PIAAC survey in 22 countries. PIAAC tested adults in literacy, numeracy, and problem solving in technology-rich environment skills that were comparable across those countries. Unlike the IALS and NAAL surveys, PIAAC had substantial sample sizes in each participating country.[39] PIAAC found that in each participating country, workers with higher literacy and numeracy skills outearned peers with lower literacy and numeracy skills.[40] Hanushek, Schwerdt, Wiederhold, and Woessmann found that among full-time workers (between ages 35 and 54) in the 22 nations studied, an increase of one standard deviation unit in numeracy skills increased the hourly wage by an average of 18 percent. The study found a wide variation across these countries in the returns to numeracy skills, with the highest returns to numeracy skills observed among workers in the United States (28 percent).[41]

The rich contents of the PIAAC database, especially the availability of data on three key measures of human capital—educational attainment, skills, and years of work experience—allow for a comprehensive measure of human capital. Using the PIAAC database for the United States, this study examines the connection between human capital and the earnings of American prime-age, full-time employed workers. The study relies on earnings regressions that are designed to estimate the independent effect of human capital variables on earnings after statistically controlling for other variables that are known to affect earnings of workers and are included in the regression as explanatory variables. These earnings regressions are often referred to as human capital earnings regressions,[42] where human capital corresponds to education and skills that determine the productivity of workers.[43]

In the remainder of this report, we present findings from multivariate regression analysis of monthly earnings (human capital earnings functions) of 25- to 54-year-old full-time employed workers in the United States. The human capital earnings functions estimated in this report are based on Jacob Mincer's framework, with the dependent variable in these regression models consisting of the natural log of earnings (the natural log of the monthly earnings of 25- to 54-year-old full-time employed workers) and measures of human capital included as explanatory variables.[44]

An important measure of human capital included in these regressions is the skills of workers. In this study, the skills of workers are measured by their literacy and numeracy proficiencies. Although not a direct measure of ability, proficiency scores of workers are included in the regressions to measure the independent effect of basic skills and education on earnings. Gary Becker contends that the regression-estimated earnings premium to schooling tends to be biased upward and attributes this bias to ability. He contends that a college education accounts for only part of the earnings premium of college-educated workers over high school graduate counterparts. He attributes about 12 percent of the earnings premium of college graduates relative to high school graduates to the fact that college graduates possess a greater ability over high school graduates that would result in higher earnings among them even if they did not graduate from college.[45] A similar upward bias in the rate of return to schooling was estimated by Griliches and Mason.[46]

Higher ability is rewarded in the labor market because it improves worker performance. Furthermore, people with higher abilities are more trainable because higher abilities are associated with a higher aptitude for learning. Although the literacy and numeracy proficiencies of workers measured in PIAAC data might not exactly measure the "ability" of workers to perform in a specific work setting, they do provide an important measure of cognitive skills that are required to perform effectively across the wide array of jobs in the labor market.

The other two measures of human capital, educational attainment and work experience, are also key determinants of the level of earnings of workers. Educational attainment represents a measure of formal investment in human capital, while work experience represents additions to individual productive capabilities that are acquired through post-school on-the-job learning. These gains in the productive abilities of individuals are most often acquired informally through everyday work activities but sometimes are acquired in more formal programs of on-the-job training including apprenticeship and cooperative education. Wages are expected to increase with additional years of work experience because workers acquire additional skills and move on to higher paying positions as they gain occupational and workplace knowledge and develop key workplace social skills.

Multivariate Regression Analysis of Earnings

Descriptive findings presented in previous sections of this report revealed a positive connection between levels of educational attainment and skills and a strong positive connection between skills and earnings. Workers with higher levels of education had higher earnings than workers with lower levels of education. However, within groups of equally educated workers, there were sizable differences in the mean earnings of workers by their literacy and numeracy proficiency. Earnings of workers are positively related to education, because education raises the knowledge and skills of individuals and makes them more productive in the workplace. However, if education fails to enhance the skills of workers, the link between education and earnings is likely to weaken.

Education and skills are measures of human capital that are related. Education bolsters literacy and numeracy proficiencies of students, and higher levels of literacy and numeracy skills bolster the chances of higher levels of educational attainment. Individuals with higher levels of skills and cognitive abilities are more likely to seek and complete higher levels of education to earn educational credentials. Our study of Philadelphia public high school graduates found sizable impacts of standardized math and reading test scores on the likelihood of enrolling in college, persisting through college, and completing college with a credential.[47]

The analysis of PIAAC data for U.S. workers presented in previous sections of this report is important in describing patterns in the data, but it does not isolate the independent effects of human capital measures and other background traits (job traits, employment-related workers traits, and demographic traits of workers) on the monthly earnings of workers. To identify the independent effect of these variables, particularly human capital variables, on the earnings of workers, we have estimated a set of multivariate earnings regression models.

The earnings functions estimated in this report are an expanded version of the basic Mincerian human capital earnings function. They include all three measures of human capital as explanatory variables as well as a number of other covariates known to influence the level of earnings of workers. The three measures of human capital are specified in these regressions as described below.

Education is represented with a set of dummy variables for each educational credential included in the PIAAC data files such as high school diploma, post-high school certificate, associate's degree, bachelor's degree, and postgraduate degrees. Work experience is entered in the regression as a nonlinear variable; it is specified as a quadratic variable to represent the following prediction of the human capital model—that earnings increase with additional work experience, but that these gains occur at a diminishing rate, reaching a maximum at a certain level of work experience. The third measure of human capital, skills of workers, is specified in two different ways—the first is with standardized scores of workers on the PIAAC literacy and numeracy tests and the second with PIAAC levels of literacy and numeracy proficiency of workers.

The earnings functions are estimated with a series of regressions designed to focus on the human capital of workers, particularly their literacy and numeracy proficiencies. We have followed a slightly different order from a standard Mincerian human capital earnings function that typically begins with education and work experience before the addition of skills/abilities and other covariates. Because of our focus on skills, the earnings functions that we have estimated begin with skills (the literacy and numeracy proficiencies of workers), followed by blocks of variables representing the educational attainment of workers and years of work experience, English writing ability, the characteristics of the job in which they were employed, the employment-related traits of workers, and the demographic traits of workers.

These regressions are designed to measure the independent effect of human capital traits of workers on earnings. We have estimated six earnings regressions. The explanatory variables in each of these regressions are presented in the top half of Box 1. As noted above, worker skills were represented in these regressions with PIAAC literacy and numeracy proficiencies, and the earnings regressions were estimated using two different specifications of each proficiency measure. Thus, four sets of the six earnings regressions were estimated—two sets for two specifications of the literacy proficiency of workers and another two sets for two specifications of the numeracy proficiency of workers. The four sets of these six regressions are presented in the lower half of Box 1.

Box 1: Multivariate Earnings Regression Models

SIX EARNINGS REGRESSION MODELS

The explanatory variable blocks in each of the six regression models are listed below:

Human capital traits:

Model 1: Literacy / numeracy proficiency

Model 2: Model 1 plus educational attainment

Model 3: Model 2 plus paid work experience and English writing ability

Job characteristics and employment-related traits of workers:

Model 4: Model 3 plus sector of employment and occupation

Model 5: Model 4 plus weekly hours of work, school enrollment status, and place of residence

Demographic traits of workers:

Model 6: Model 5 plus gender, race-ethnicity, foreign-born status, and disability status

FOUR EARNINGS REGRESSION MODELS

Four sets of earnings regressions were estimated, each consisting of six regression models described above. The four sets of regressions differ on the specification of the explanatory variable measuring skills as follows:

Set A: Skills specified as standardized score on the literacy test

Set B: Skills specified as standardized score on the numeracy test

Set C: Skills specified as levels of literacy proficiency

Set D: Skills specified as levels of numeracy proficiency

The Effects of Literacy and Numeracy Proficiencies on Earnings

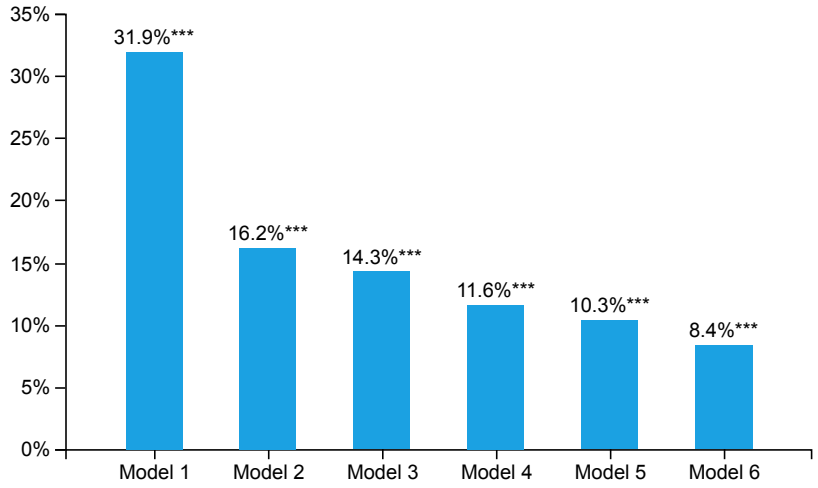
A summary of the effects of standardized scores of literacy and numeracy proficiencies of 25- to 54-year-old full-time employed workers on their monthly earnings estimated from Set A (where skills are specified as standardized score on the literacy test) and Set B (where skills are specified as standardized score on the numeracy test) of the six regression models are presented in figures 11 and 12.[48] According to Set A-Model 1, which includes just one explanatory variable, the standardized literacy test score, an increase of one standard deviation unit in the literacy test score is expected to increase monthly earnings by nearly 32 percent (Figure 11). The explanatory power (adjusted R-squared) of this regression (Set A-Model 1) was .187—that is, literacy skills explain just under one-fifth of the variation in the earnings of 25- to 54-year-old full-time employed workers.

The addition of more explanatory variables in the earnings regression models is expected to reduce the regression-adjusted measure of the effect of skills on earnings since these explanatory variables that measure worker and job traits are also known to correlate with earnings. Regression-adjusted effects measure the "independent" effect of an explanatory variable on the dependent variable after statistically controlling for the effects of other explanatory variables included in the regression. Adding the educational attainment measure in Set A-Model 2 halved the effect of literacy proficiency on monthly earnings—that is, one standard deviation unit change in the literacy proficiency of workers is expected to increase earnings by 16 percent. The R-squared of Set A-Model 2 increased from .187 to .284, representing an increase of over 50 percent in the variance accounted for in Set A-Model 2 compared to that in Set A-Model 1. However, the independent (regression-adjusted) effect of literacy skills on earnings remained large and statistically significant.

The addition of two more variables measuring human capital—paid work experience and English writing ability—in Set A-Model 3 reduced the estimated effect of one standard deviation unit change in the literacy score to 14 percent (significant at the .01 level) and raised the R-squared to .344. Set A-Model 4, which added the following two variables measuring job traits—occupation and sector of employment—estimated an 11.6 percent change in earnings from one standard deviation unit change in the literacy score of workers (Figure 11). The R-squared of Set A-Model 4 rose to .405. Even after adding education, paid work experience, English writing ability, sector of employment, and occupation—traits that are strongly related to earnings—the effect of literacy skills of workers remained sizable and statistically significant.

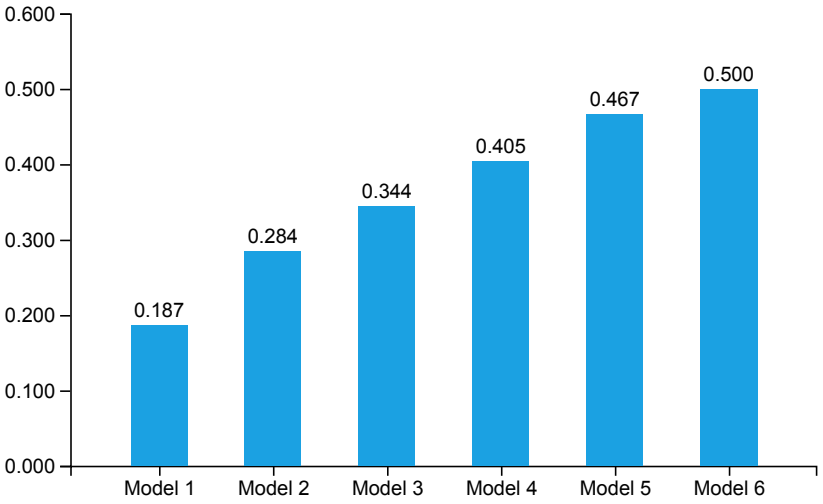
Variables measuring worker traits that are expected to influence their earnings were added as explanatory variables in the final two regression models. Set A-Model 5 added three additional explanatory variables (weekly hours of work, school enrollment status, and region of residence) representing employment-related traits of workers, and Set A-Model 6 added personal demographic traits as explanatory variables (Figure 11). The estimated regression-adjusted effect of literacy proficiency in these last two regression models in Set A further declined to 10.3 percent with the addition of job-related worker traits to explanatory variables in Set A-Model 5, and 8.4 percent in Set A-Model 6, which added demographic traits of workers to the regression's explanatory variables.

Figure 11: Estimated Percentage Change on the Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers from One Standard Deviation Unit Change in the Literacy Score, 2012-2014 (Estimated from Earnings Regression Models, Set A-Models 1-6)



Statistical significance: *** sig. at .01 level.

Set A R-Squared

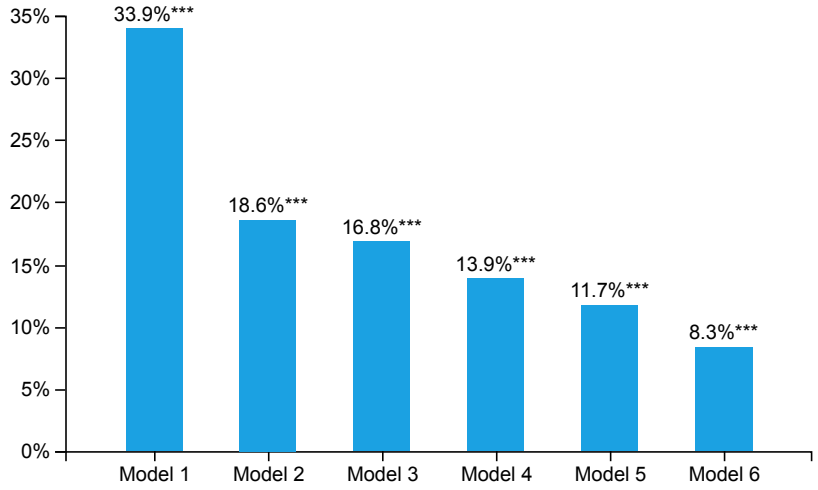


Explanatory variables in regression models: Model 1: standardized literacy score; Model 2: Model 1 plus educational attainment; Model 3: Model 2 plus paid work experience and English writing ability, Model 4: Model 3 plus sector of employment and occupation; Model 5: Model 4 plus weekly hours of work, school enrollment status, and place of residence; Model 6: Model 5 plus gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

These estimates of the percentage effect of literacy proficiency on earnings in all six models measure the effect of one standard deviation unit change in the literacy score of workers on their monthly earnings after statistically adjusting for the effects on earnings of other explanatory variables included in these regression models. The explanatory power of the earnings regression models also rose in models 5 and 6: .467 in Model 5 and .500 in Model 6 (Figure 11). The .500 R-squared of the full regression model (Model 6) means that this model explains one-half of the variation in the monthly earnings of 25- to 54-year-old full-time employed workers. Although 50 percent of the variation in earnings explained (measured by .500 R-squared) in cross-section data is considerable, the remaining 50 percent of the variation in earnings is not captured by the explanatory variables included in the full regression model and could be attributable to a variety of factors that are not available in PIAAC data or attributes that are not easily measurable.

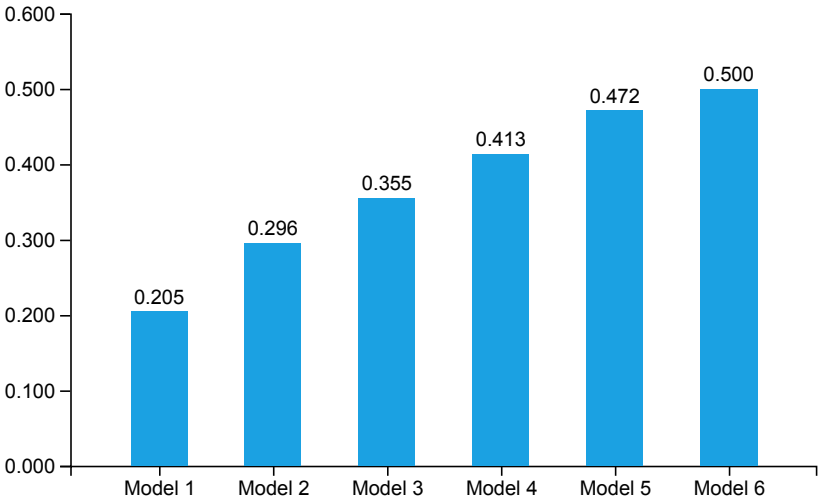
The regression-adjusted effect of numeracy proficiencies on the earnings of workers that are measured in Set B earnings regression models 1 through 6 are presented in Figure 12. Although the findings of numeracy proficiencies are similar to that of literacy proficiencies, the regression-adjusted effect of numeracy proficiencies on the earnings of workers was somewhat higher in models 1 through 5 of Set B compared to estimates of the regression-adjusted effect of literacy proficiency in models 1 through 5 of Set A. However, in the full model (Model 6), the regression-adjusted effect of numeracy proficiency (Set B-Model 6) was about the same as the regression-adjusted effect of literacy proficiencies estimated in Set A-Model 6. In Set B-Model 1, the coefficient of the standardized numeracy proficiency score variable was .292, representing a percent effect on earnings of 34 percent. In other words, one standard deviation unit increase in the numeracy test score is expected to increase monthly earnings by nearly 34 percent. The percent effect of numeracy proficiency on earnings falls to 18.6 percent with the addition of educational attainment as explanatory variables of the regression in Set B-Model 2. In other words, after statistically controlling for the effect of educational attainment on earnings, the independent effect of one standard deviation unit change in workers' numeracy proficiency score is estimated to be an 18.6 percent change in earnings.

Figure 12: Estimated Percentage Change on the Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers from One Standard Deviation Unit Change in the Numeracy Score, 2012-2014 (Estimated from Earnings Regression Models, Set B-Models 1-6)



Statistical significance: *** sig. at .01 level.

Set B R-Squared



Explanatory variables in regression models: Model 1: standardized numeracy score; Model 2: Model 1 plus educational attainment; Model 3: Model 2 plus paid work experience and English writing ability; Model 4: Model 3 plus sector of employment and occupation; Model 5: Model 4 plus weekly hours of work, school enrollment status, and place of residence; Model 6: Model 5 plus gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

The size of the estimated percent effect of numeracy skills on earnings declined as the number of explanatory variables included in the regression models increased. In the full regression model (Set B-Model 6), an increase of one standard deviation unit in the numeracy skill score of workers is expected to increase earnings by 8.3 percent. The full regression model includes the explanatory variables added in each of the five regression models 1 through 5: numeracy skill score, educational attainment, work experience, English writing ability, job traits, and employment-related traits of workers along with demographic traits of workers. Even after controlling for all these variables, the independent effect of one standard deviation unit change in the numeracy proficiency score of workers on their monthly earnings remained high—8.3 percent (Figure 12). The R-squared of Set B-Model 6 (which includes the standardized numeracy score as the explanatory variable measuring skills) was .500 (Figure 12); that is identical to the R-squared for Set A-Model 6 (which includes the standardized literacy score as the explanatory variable measuring skills) (Figure 11).

The next two sets of earnings regressions (sets C and D) utilize levels of literacy and numeracy proficiencies (described in Box 1) as explanatory variables to measure skills of workers instead of standardized literacy and numeracy scores that were utilized as explanatory variables in the previous two sets of earnings regressions (sets A and B). Levels of the literacy and numeracy proficiency of workers are entered in sets C and D earnings regression models as explanatory variables with three dummy variables representing three proficiency levels—level 1 or below, level 3, and level 4/5. This specification leaves level 2 as the base or reference group against which earnings premiums/deficits of workers in the remaining three proficiency levels are assessed. The three dummy variables are defined as taking on the value 1 if workers' skills scores are at the level defined by the dummy variable and 0 otherwise.

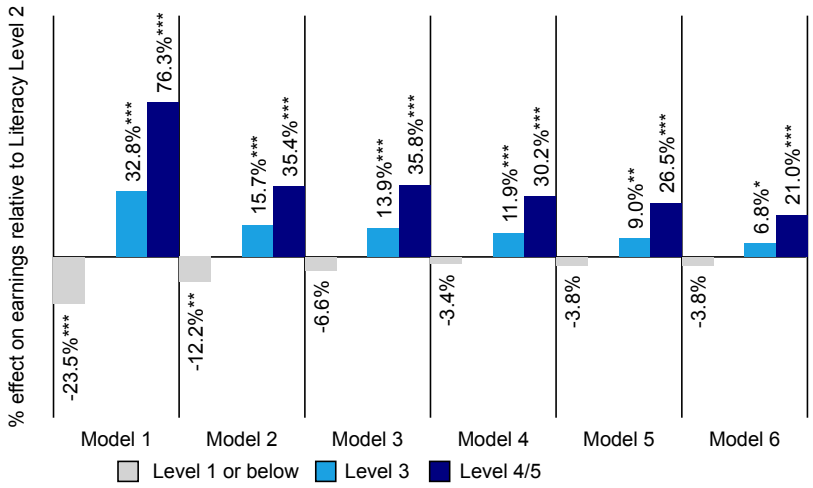
Using this specification of literacy and numeracy skills, we have estimated six earnings regressions for literacy proficiency (Set C) and another six earnings regressions for numeracy proficiency (Set D). Findings from the six regressions (Set C) on the regression-adjusted impact of the level of literacy proficiency on the monthly earnings of 25- to 54-year-old full-time employed workers are presented in Figure 13. These findings reveal that in Set C-Model 1, which included just three explanatory variables representing literacy skill levels of workers, the monthly earnings of workers with literacy skills at or below level 1 are expected to be nearly 24 percent lower than the monthly earnings of workers in level 2; workers in level 3 and level 4/5 are, respectively, expected to earn 33 percent and 76 percent more than workers in level 2 of the literacy proficiency scale.

The size of the earnings deficit of workers with level 1 or lower literacy skills compared to their counterparts in level 2 fell to 12 percent in Set C-Model 2 (with the addition of explanatory variables measuring educational attainment), meaning that the regression-adjusted earnings premium of workers in level 2 literacy skills compared to workers with level 1 or below literacy skills declined (between Set C-Model 1 and set-C Model 2) after statistically controlling for the effect of education on earnings. The sizes of earnings premiums of level 3 and levels 4/5 literacy skills also were estimated to be smaller in Set C-Model 2 than in Set D-Model 1. Similar to the findings of earnings regressions with standardized literacy scores (Set A), the regression-adjusted earnings premiums of literacy skills in level 3 and levels 4/5 fell in each successive Set C regression model with additional explanatory variables (Figure 13).

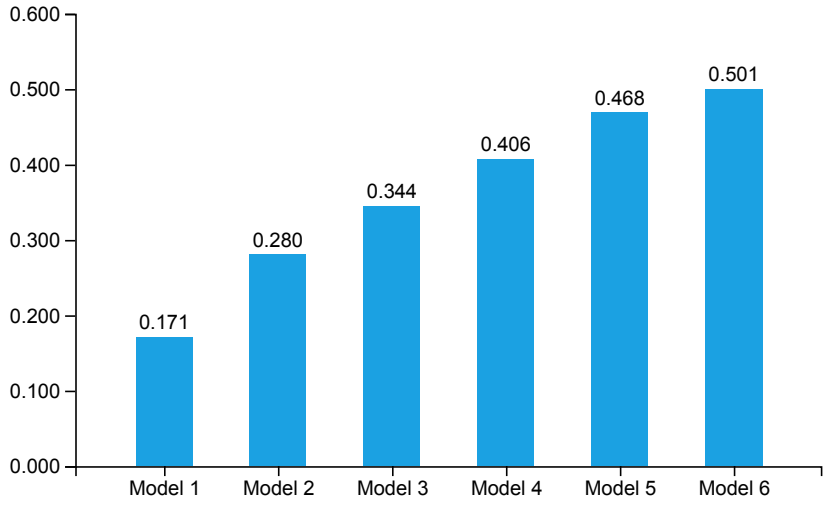
The regression-adjusted earnings difference between workers with literacy skills in level 2 and their counterparts with level 1 or below also declined with an increase in the number of explanatory variables, falling below the threshold for statistical significance after Set C-Model 2, meaning that there was no statistically significant difference between the regression-adjusted earnings of workers with literacy skills in level 1 or below and level 2 when the earnings regression models were expanded to include paid work experience and English writing ability of workers, job traits, employment-related worker traits, and demographic traits of workers as explanatory variables.

The full earnings regression model of Set C (Set C-Model 6) reveals that there was no statistically significant difference between the regression-adjusted earnings of workers in level 1 or lower and level 2 literacy skills. Workers with level 3 literacy skills are expected to earn nearly 7 percent more than workers with level 2 (significant at the .10 level), while the regression-adjusted earnings of workers with the highest level of literacy proficiencies (levels 4/5) were estimated to be 21 percent higher than that of their counterparts with level 2 literacy skills (Figure 13; Set C-Model 6).

Figure 13: Estimated Percentage Difference in the Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers with Different Levels of Literacy Proficiency Relative to the Earnings of Workers with Level 2 Literacy Proficiency, 2012-2014 (Estimated from Earnings Regression Models, Set C-Models 1-6)



Statistical significance: *** sig. at .01 level, ** sig. at .05 level, * sig. at .10 level.



Explanatory variables in regression models: Model 1: Level of literacy proficiencies; Model 2: Model 1 plus educational attainment; Model 3: Model 2 plus paid work experience and English writing ability; Model 4: Model 3 plus sector of employment and occupation; Model 5: Model 4 plus weekly hours of work, school enrollment status, and place of residence; Model 6: Model 5 plus gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Findings from the final set of six earnings regression models, Set D, are presented in Figure 14. As noted above, this set of earnings regression models includes levels of the numeracy proficiency of workers as explanatory variables measuring skills of workers. Similar to regressions in Set C that included literacy proficiency levels as explanatory variables to measure worker skills, regressions in Set D included three dummy variables to represent three levels of the numeracy proficiency of workers: level 1 or below, level 3, and levels 4/5. The estimated regression coefficients of these three dummy variables represent measures of the regression-adjusted earnings premium or deficit of workers with these three numeracy proficiency levels compared to the earnings of workers with level 2 numeracy skills.

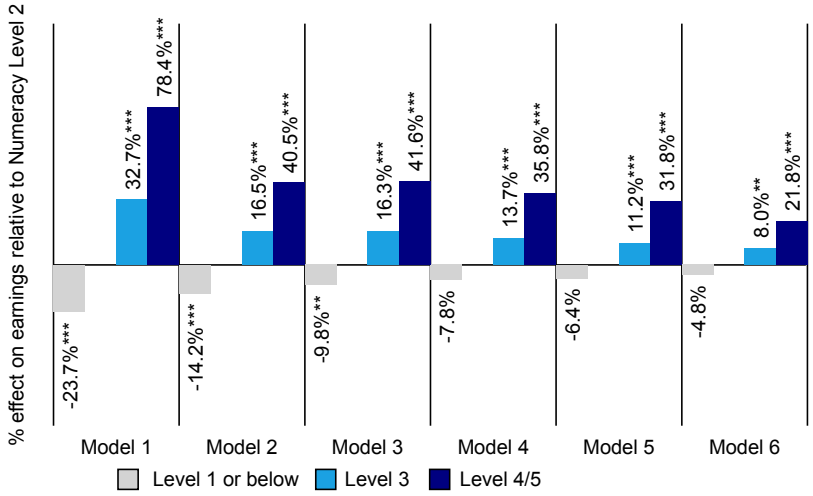
Regression of monthly earnings of workers on their numeracy skill levels (Set D-Model 1) found that relative to workers with level 2 numeracy proficiency, those with level 1 or lower were expected to earn 24 percent less, while workers with level 3 and levels 4/5 numeracy proficiencies were expected to earn 33 percent and 78 percent more, respectively. Similar to each of the three sets of regressions discussed above (Set A, B, and C), the regression-adjusted effect of numeracy skills on earnings of workers declined with each regression that included additional blocks of explanatory variables (Figure 14).

The addition of educational attainment (Set D-Model 2) reduced the regression-adjusted earnings difference relative to workers with level 2 numeracy proficiency to -14 percent among workers with numeracy proficiencies at or below level 1 (down from -24% in Set D-Model 1); to 17 percent among level 3 workers (down from 33% in Set D-Model 6); and to 41 percent among level 4/5 workers (down from 78% in Set D-Model 1). The addition of two more measures of human capital to the explanatory variables in Model 3 (paid work experience and English writing ability) further reduced the regression-adjusted earnings deficit of workers in level 1 or below compared to workers in level

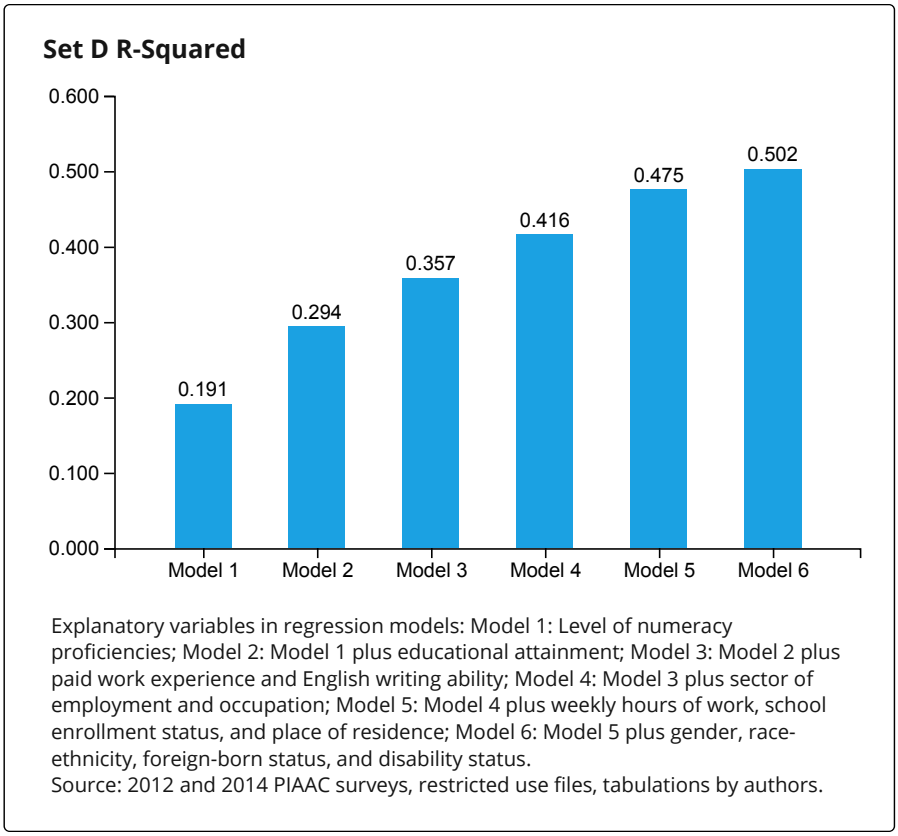
2 to 9.8 percent (down from -14 percent in Set D-Model 2). The regression-adjusted earnings premiums of workers in levels 3 and 4/5 remained almost unchanged in Set D-Model 3 from the levels estimated in Set D-Model 2 (Figure 14).

In models 4, 5, and 6 where job traits, employment-related traits, and demographic traits of workers were added as explanatory variables, the regression-adjusted earnings deficit of workers in level 1 or below relative to workers in level 2 was not statistically significant; in other words there was no statistically significant difference in the regression-adjusted earnings of workers in the bottom two levels of the numeracy proficiency scale. At the higher end of the numeracy proficiency scale, the addition of job traits, employment-related traits, and demographic traits of workers as explanatory variables steadily reduced the estimated size of the earnings premium in level 3 and levels 4/5 of the numeracy scale (relative to level 2) down to 8 percent (significant at the .05 level) and 21.8 percent (significant at the .01 level), respectively (Figure 14).

Figure 14: Estimated Percentage Difference in the Monthly Earnings of 25- to 54-Year-Old Full-Time Employed Workers with Different Levels of Numeracy Proficiency Relative to the Earnings of Workers with Level 2 Numeracy Proficiency, 2012-2014 (Estimated from Earnings Regression Models, Set D-Models 1-6)



Statistical significance: *** sig. at .01 level, ** sig. at .05 level.



Explanatory variables in regression models: Model 1: Level of numeracy proficiencies; Model 2: Model 1 plus educational attainment; Model 3: Model 2 plus paid work experience and English writing ability; Model 4: Model 3 plus sector of employment and occupation; Model 5: Model 4 plus weekly hours of work, school enrollment status, and place of residence; Model 6: Model 5 plus gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

The explanatory power of the earnings regressions increased with each additional block of explanatory variables. Model 1, which had just the level of numeracy proficiencies as explanatory variables, had an R-squared of .191. The addition of education in Model 2 increased the explanatory power to .294, followed by another increase in the R-squared to .357, when all human capital traits were included as explanatory variables in the regressions. Job traits, particularly occupation, also are closely related to earnings. The addition of job traits to the explanatory variables of the regression increased the R-squared to .416. The R-squared increased to .475 in Set D-Model 5 that controlled for weekly hours of work, school enrollment status, and the region of residence of workers. The full model, which included all the variables in Model 5 plus demographic traits of workers with an R-squared of .502, explained one-half of the variation in the monthly earnings of 25- to 54-year-old full-time employed workers (Figure 14). The explanatory power of the full model (Model 6) in each of the four sets of earnings regressions was almost identical: .500 in Set A-Model 6, .500 in Set B-Model 6, .501 in Set C-Model 6, and .502 in Set D-Model 6.

The coefficients, percent effects, and statistical significance of all explanatory variables in each of the six earnings regression models in all four sets are presented in Appendix tables D-1 through D-8. A detailed discussion of the findings from the full earnings regression model (Model 6) of sets A, B, C, and D is presented below.

Effects of Literacy and Numeracy Proficiencies, Educational Attainment, and Other Explanatory Variables on Earnings

In addition to literacy and numeracy proficiencies, the human capital earnings regressions that we have estimated for 25- to 54-year-old full-time employed workers included a number of other explanatory variables that are known to affect earnings. In the preceding section we have presented findings from a series of regressions with a particular focus on the regression-adjusted connection between earnings and skills. In this section, we present the complete regression findings for the full model (Model 6) that contains covariates of human capital traits of workers, job traits, employment-related traits of workers, and demographic traits of workers. The full earnings regression model (Model 6) was estimated separately four times, each with a different specification of skills.[49] In keeping with the numbering system used for the discussion of regression findings in this report, tables 5 through 8 contain findings from the following four earnings regressions: Set A-Model 6 (standardized literacy test score), Set B-Model 6 (standardized numeracy test score), Set C-Model 6 (literacy proficiency levels), and Set D-Model 6 (numeracy proficiency levels).[50] The R-squared for each of these four models ranges from .500 to .502, meaning that these models explain half of the variation in the monthly earnings of 25- to 54-year-old full-time employed workers in 2012-2014.

Findings presented in these tables contain the percent effect of a one unit change in each explanatory variable on the monthly earnings of 25- to 54-year-old full-time workers. The first column (column A) contains findings from earnings regressions in Set A-Model 6 in which the skills of workers was specified as the standardized literacy proficiency test score. Columns B, C, and D present findings from the same earnings regressions (Model 6) except with different measures of proficiency: standardized numeracy proficiency test score in Set B-Model 6 (Col. B), literacy proficiency levels in Set C-Model 6 (Col. C), and numeracy proficiency levels in Set D-Model 6 (Col. D).

Human Capital Traits of Workers

The discussion of literacy and numeracy proficiencies of prime-age, full-time workers found that these basic skills are closely related to their earnings. Even in the regression models that control for a wide variety of worker characteristics and job traits, literacy/numeracy proficiencies of workers are found to have a strong effect on their earnings (figures 11 to 14). The full regression models also find that educational attainment exerts a strong and positive impact on the earnings of prime-age, full-time employed workers at the bachelor's degree level or higher. Earning a bachelor's degree had the effect of increasing monthly earnings by about 30 percent relative to high school graduates in each of the full regression models (Model 6) of sets A, B, C, and D. Similarly, full-time workers with a master's degree are expected to earn between 43 to 45 percent more than high school graduates. And, the regression-adjusted monthly earnings premium of workers with a professional degree relative to the base group of high school graduates is estimated to be 60 percent in each of the four full regression models (Table 5).

High school dropouts had regression-adjusted earnings that were about 16 to 17 percent below those of high school graduates. It is of special importance to note that among prime-age, full-time employed workers, the regression-adjusted earnings of those with some college, but no degree or certificate award, were not significantly different from the earnings of their high school graduate counterparts. Furthermore, three out of the four full regression models found no statistically significant regression-adjusted earnings advantage relative to high school graduates among workers with an associate's degree, and the fourth model measured only a marginally significant regression-adjusted earnings advantage for workers with an associate's degree relative to those with just a high school diploma (Table 5). These findings are of considerable importance since a very large share of the nation's workforce falls in one of these two educational categories.

Paid work experience is considered to be another form of human capital. As workers gain labor market experience, they learn new skills and knowledge and improve the skills and knowledge that they already possess. Additional work experience also provides workers with seniority that is frequently accompanied with higher pay. Paid work experience is expected to have a strong positive effect on the earnings of workers. Descriptive analysis of PIAAC data shows a strong and positive connection between paid work experience and monthly earnings of workers (Appendix F). Compared to workers with less than 10 years of paid work experience, the earnings premiums of workers with higher levels of paid work experience ranged from 17 percent for 10-19 years, to 40 percent for 20-29 years, to 43 percent for 30-plus years. Mean monthly earnings for all subgroups of workers included in the full earnings regressions models are presented in Appendix F.

Human capital earnings functions include work experience as an explanatory variable with a quadratic specification to capture the relationship between work experience and earnings postulated by Mincer, that is, earnings rise with additional work experience but at a diminishing rate.[51] Earnings increase with work experience: sharply for the first few years, followed by a more gradual rate of increase. Indeed, findings from our earnings regression analysis support this relationship between work experience and earnings. An additional year of work experience is expected to raise monthly earnings by 3.1 to 3.3 percent, holding everything else constant (Table 5). The negative and statistically significant coefficient on the experience-squared variable indicates that the earnings of workers grow with additional work experience, but the rate of earnings growth slows down as the years of work experience increases (diminishing returns to additional years of work experience), which means that at a certain level of work experience, monthly earnings will be maximized (about 15.7 years based on estimated regression coefficients of the two work experience variables in the full regression models). Regression findings for paid work experience were similar across all four earnings regressions presented in Table 5.

English language proficiency is vital in the U.S. labor market. English language skill is closely linked with earnings, employment, and other labor market outcomes of workers, particularly foreign-born workers. The English speaking ability of immigrants was found to be closely connected with their employment and earnings outcomes as well as other social outcomes such as attainment of U.S. citizenship.[52] In PIAAC 2012-2014 surveys, all respondents (foreign-born as well as native-born) were asked questions about their English language proficiency.[53] Respondents were asked to self-assess their ability to understand spoken English, read English, speak English, and write English. They were asked to select one of the following four options to rate their English language proficiency: very well, well, not well, and not at all. We found that the mean monthly earnings of workers were strongly linked to their English writing ability.

Table 5: Percent Change in Expected Monthly Earnings from One-Unit Increase In Predictor Variables in Full Regression Models for 25- to 54-Year-Old Full-Time Employed Workers (Findings for a Subset of Explanatory Variables Measuring Human Capital)

EXPLANATORY VARIABLES	(A) SET A-FULL MODEL 6: STANDARDIZED LITERACY PROFICIENCY SCORE	(B) SET B-FULL MODEL 6: WITH STANDARDIZED NUMERACY PROFICIENCY SCORE	(C) SET C-FULL MODEL 6: WITH LITERACY PROFICIENCY LEVELS	(D) SET D-FULL MODEL 6: WITH NUMERACY PROFICIENCY LEVELS
STANDARDIZED PROFICIENCY SCORE-PLAUSIBLE VALUES (PVS)				
PVLITERACY OR PVNUMERACY	8.4***	8.3***	---	---
PROFICIENCY LEVELS (BASE GROUP IS LEVEL 2)				
LEVEL 1	---	---	-3.8	-4.8
LEVEL 3	---	---	6.8*	8.0**
LEVELS 4/5	---	---	21.0***	21.8***
EDUCATIONAL ATTAINMENT (BASE GROUP IS HIGH SCHOOL GRADUATES)				
NO H.S. DIPLOMA	-15.6***	-16.1***	-17.5***	-17.5***
SOME COLLEGE	0.7	0.7	1.3	1.2
CERTIFICATION	1.9	1.3	2.6	1.8
ASSOCIATE'S DEGREE	6.2	5.8	6.8*	6.3
BACHELOR'S DEGREE	30.0***	28.9***	30.5***	28.9***
MASTER'S DEGREE	44.9***	43.5***	45.2***	43.0***
PROFESSIONAL DEGREE	60.3***	59.7***	60.5***	59.4***
DOCTORATE DEGREE	56.5***	54.8***	56.0***	53.0***
YEARS OF WORK EXPERIENCE (CONTINUOUS VARIABLE, RANGE: 0-47)				
EXPERIENCE	3.1***	3.3***	3.3***	3.3***
EXPERIENCE SQUARED	-0.1***	-0.1***	-0.1***	-0.1***
ENGLISH WRITING ABILITY (BASE GROUP IS ENGLISH WRITING ABILITY "WELL")				
VERY WELL	0.1	0.7	0.4	0.8
NOT WELL OR NOT AT ALL	-8.2	-8.8	-11.2*	-11.0
R-SQUARED	0.500	0.500	0.501	0.502

Statistical significance: *** sig. at .01 level, ** sig. at .05 level, * sig. at .10 level.
Explanatory variables in full regression model (Model 6): Literacy/Numeracy proficiencies; educational attainment; paid work experience, English writing ability sector of employment, occupation, weekly hours of work, school enrollment status, region of residence, gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

In our full earnings regression model, we included variables representing self-reported English writing ability of workers for "very well," "not well," and "not at all." Workers who reported their English writing ability as "well" were included in the base group. Findings presented in Table 5 (Col. A) reveal that among prime working age (25- to 54-year-old), full-time employed workers, the regression-adjusted earnings of workers in the base group ("well" English writing ability) were not expected to be statistically different from that of their counterparts with the best English writing ability ("very well") or with poor English writing ability ("not well" or "not at all"). Although the mean monthly earnings of these workers varied by their English writing ability (see Appendix F), after controlling for all the other covariates included in the full earnings regression model, coefficients of both measures of the English writing ability of workers were not statistically significant (Table 5, Col. B). Similar findings were noted in the remaining three earnings regressions presented in Table 5, columns B, C, and D.

Job Traits: Characteristics of the Jobs of Workers

Also included in the full earnings regression models are variables that represent characteristics of the jobs of workers. One of these variables is the economic sector of employment of workers. Workers' wages vary by the economic sector in which they were employed. A recent report by the Congressional Budget Office shows that workers without a college degree employed in federal government jobs had 21 percent higher wages than their comparable peers employed in the private sector, whereas workers with a Ph.D. or professional degree who were employed in the federal government sector earned 23 percent *less* than peers in the private sector.[54]

In the PIAAC survey, workers were asked to report their economic sector of employment. Responses were grouped into the following three sectors in the PIAAC data file: the private for-profit sector, the public sector, and the nonprofit sector. We have added two explanatory variables to the full earnings regression model: the nonprofit sector and the public sector. The base group includes workers employed in the private for-profit sector.

Regression analysis (see Table 6) found that even after controlling for the skills, education, and other job traits—employment-related traits of workers, and demographic traits of workers—the monthly earnings of 25- to 54-year-old workers employed full-time in the nonprofit sector were expected to be nearly 11 percent less than the earnings of those employed in the private for-profit sector (statistically significant at the .05 level), and those working in the public sector were expected to earn 5 percent less than the base group (private for-profit sector workers; significant at the .10 level). Similar findings were noted in the remaining three regressions in Table 7 that used the standardized numeracy proficiency score, literacy proficiency levels, or numeracy proficiency levels as explanatory variables representing worker skills.

Another important job trait that is closely related to the earnings of workers is occupation. Occupations represent what workers do on the job and are closely related to the knowledge, ability, and skills of workers. Occupations that require high level of skills can be staffed with only highly skilled and educated workers who can perform the required tasks. These occupations pay high wages that are required to attract and adequately compensate workers with high levels of human capital in the form of skills and educational attainment. In fact, the earnings premiums associated with a college education are closely connected to access to jobs in high-level occupations —sometimes known as college labor market occupations—because these occupations require the skills, knowledge, and abilities that are typically acquired with a college education.[55]

Using the skill-based classification of occupations in PIAAC data, we have divided 25- to 54-year-old full-time employed workers into the following four groups: workers employed in skilled occupations, semi-skilled white-collar occupations, semi-skilled blue-collar occupations, and elementary occupations. A few examples of occupations in each group are presented below:[56]

- skilled occupations—professional, technical, managerial, and high level sales occupations such as executives, managers, engineers, scientists, health practitioners, IT professionals, teaching professionals/educators, lawyers and judges, insurance/finance/real estate sales
- semi-skilled white collar occupations—administrative support and clerical occupations, personal services, protective services occupations
- semi-skilled blue-collar occupations—construction workers, machine assemblers/operators /repairers, vehicle operators
- elementary occupations—laborers, helpers, handlers

Prime-age, full-time employed workers were distributed across the four major occupational groups as follows: skilled occupations (54.5 percent), semi-skilled white-collar occupations (23 percent), semi-skilled blue-collar occupations (17.5 percent), and elementary occupations (5 percent). The occupational distribution of all employed workers (aged 16 years or older) had somewhat higher shares of workers in lower level occupations: skilled occupations (48 percent), semi-skilled white-collar occupations (26 percent), semi-skilled blue-collar occupations (16 percent), and elementary occupations (8 percent).

Earnings of workers varied widely by occupation. The mean monthly earnings of 25- to 54-year-old full-time employed workers were highest among workers in skilled occupations ($5,968), followed by $3,589 among semi-skilled blue-collar workers (40 percent lower than skilled occupations), $3,136 among semi-skilled white-collar workers (47 percent lower than skilled occupations), and just $2,448 among elementary occupation workers (59 percent lower than skilled occupations).

As mentioned above, occupations are included in the earnings regressions as a set of explanatory variables representing job traits and consisting of three dummy variables representing semi-skilled white-collar, semi-skilled blue-collar, and elementary occupations. Skilled occupations are used to represent the base group. Earnings differentials between workers in each of the four occupational categories remained large even after statistically controlling for human capital and other job traits, job-related worker traits, and demographic traits of workers. Findings in Table 6 (col. B) indicate that compared to 25- to 54-year-old full-time employed workers employed in skilled occupations (the base group), their counterparts employed in other occupations were expected to earn 23 percent less in semi-skilled blue-collar occupations, 27 percent less in semi-skilled white-collar occupations, and 35 percent less in elementary occupations. These regression-adjusted earnings differentials by occupation were the same across all four regression models presented in Table 7.

Table 6: Percent Change in Expected Monthly Earnings from One-Unit Increase In Predictor Variables in Full Regression Models for 25- to 54-Year-Old Full-Time Employed Workers (Findings for a Subset of Explanatory Variables Measuring Job Characteristics)

EXPLANATORY VARIABLES	(A) SET A-FULL MODEL 6: STANDARDIZED LITERACY PROFICIENCY SCORE	(B) SET B-FULL MODEL 6: WITH STANDARDIZED NUMERACY PROFICIENCY SCORE	(C) SET C-FULL MODEL 6: WITH LITERACY PROFICIENCY LEVELS	(D) SET D-FULL MODEL 6: WITH NUMERACY PROFICIENCY LEVELS
ECONOMIC SECTOR OF EMPLOYMENT (BASE GROUP IS FOR-PROFIT PRIVATE SECTOR)				
NONPROFIT SECTOR	-10.6**	-10.9***	-10.7**	-10.7**
PUBLIC SECTOR	-5.1*	-4.6	-5.0*	-4.5
OCCUPATION (BASE GROUP IS SKILLED OCCUPATIONS)				
SEMI-SKILLED WHITE-COLLAR OCCUPATIONS	-26.6***	-26.8***	-26.6***	-26.9***
SEMI-SKILLED BLUE-COLLAR OCCUPATIONS	-23.0***	-23.7***	-22.7***	-23.2***
ELEMENTARY OCCUPATIONS	-35.1***	-35.7***	-35.3***	-35.5***
OCCUPATIONS MISSING	-11.3	-12.5	-11.1	-12.3
R-SQUARED	0.500	0.500	0.501	0.502

Statistical significance: *** sig. at .01 level, ** sig. at .05 level, * sig. at .10 level.
Explanatory variables in full regression model (Model 6): Literacy/Numeracy proficiencies; educational attainment; paid work experience, English writing ability sector of employment, occupation, weekly hours of work, school enrollment status, region of residence, gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Employment-Related Traits of Workers

The next three groups of explanatory variables in the earnings regressions presented in Table 7 represent employment-related worker traits. These traits include their school enrollment status, weekly hours of work, and the region in which they reside. The first of these three employment-related traits of workers is their school enrollment status. Workers who are enrolled in school are expected to have lower earnings for a number of reasons. School-enrolled workers are generally younger and are still in the process of securing the labor market work experience that will raise their earnings in the future. Also, these workers are engaged in their education, which will result in higher earnings in the future. Furthermore school-enrolled workers are less likely to be fully engaged in the labor market as part of their time is spent on schooling activities—even when working a full-time weekly work schedule. The full earnings regression models presented in Table 7 found that workers who were enrolled in school during the PIAAC surveys were expected to earn between 8.3 and 8.9 percent less than their counterparts who were not enrolled in school. The school enrollment coefficient was statistically significant at the .01 level in all four full regression models (Table 8).

The monthly earnings of workers are closely related to the wages that workers earn per hour and the number of hours of work that they perform per week during the month. PIAAC data provide information on the number of hours that workers worked per week at the time of the PIAAC survey. This variable, representing job traits, is included in the full earnings regression model as a continuous variable between 35 and 60 hours. Findings show a strong and positive connection between weekly hours of work and monthly earnings of 25- to 54-year-old full-time employed workers; each additional hour of work is expected to increase monthly earnings of workers by 1.8 percent, holding all other explanatory variables constant (Table 8).

Earnings of workers also vary by location. Variations in labor supply and demand, cost of living, local institutions, policies and regulations, and other labor market variations result in geographic variations in earnings. The PIAAC data file provides data on the residence of respondents. We have used the region of residence of workers as explanatory variables in the earnings regressions to capture the geographic variation in the monthly earnings of workers. Descriptive measures of the regional differences in earnings (Appendix F) found that the mean monthly earnings of workers in the Northeast ($5,228) and the West ($5,055) exceeded earnings of their counterparts in the South ($4,413) by 18 percent and 15 percent, respectively, while the earning of workers in the Midwest ($4,530) were only 3 percent higher than that of their counterparts residing in the South.

Earnings regressions found statistically significant differences in the earnings of workers by region. Workers in the Northeast region and the West region were expected to earn 10.6 percent and 12.6 percent, respectively, higher monthly earnings than workers residing in the South region, holding constant human capital traits, job traits, employment-related worker traits, and demographic traits of workers. These two coefficients were statistically significant at the .05 level in each of the four full regression models (Table 7). The coefficient on the Midwest region was positive, but not statistically significant.

Table 7: Percent Change in Expected Monthly Earnings from One-Unit Increase In Predictor Variables in Full Regression Models for 25- to 54-Year-Old Full-Time Employed Workers (Findings for a Subset of Explanatory Variables Measuring Employment-Related Traits of Workers)

EXPLANATORY VARIABLES	(A) SET A-FULL MODEL 6: STANDARDIZED LITERACY PROFICIENCY SCORE	(B) SET B-FULL MODEL 6: WITH STANDARDIZED NUMERACY PROFICIENCY SCORE	(C) SET C-FULL MODEL 6: WITH LITERACY PROFICIENCY LEVELS	(D) SET D-FULL MODEL 6: WITH NUMERACY PROFICIENCY LEVELS
SCHOOL ENROLLMENT STATUS (BASE GROUP IS NOT ENROLLED IN SCHOOL)				
ENROLLED IN SCHOOL	-8.6**	-8.9**	-8.3**	-8.8**
WEEKLY HOURS OF WORK (CONTINUOUS VARIABLE, RANGE: 35-60)				
WEEKLY HOURS	1.8***	1.7***	1.8***	1.8***
REGION OF RESIDENCE (BASE GROUP IS SOUTH REGION)				
NORTHEAST	10.6**	10.7**	10.6**	10.6**
MIDWEST	5.1	5.2	5.1	5.1
WEST	12.6**	12.6**	12.6**	12.6**
R-SQUARED	0.500	0.500	0.501	0.502

Statistical significance: *** sig. at .01 level, ** sig. at .05 level.
Explanatory variables in full regression model (Model 6): Literacy/Numeracy proficiencies; educational attainment; paid work experience, English writing ability sector of employment, occupation, weekly hours of work, school enrollment status, region of residence, gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

Demographic Traits of Workers

The last set of covariates in the full earnings regressions model consists of variables representing demographic traits of workers. The following four demographic traits of workers are included as explanatory variables in the earnings regressions: gender, race-ethnicity, foreign-born status, and disability status. Mean monthly earnings of 25- to 54-year-old full-time employed workers included in this study varied widely by these four demographic characteristics (Appendix F).

The four models presented in Table 8 estimated the value of the male coefficient at between .22 and .24, meaning that, with all else remaining the same, the monthly earnings of men were expected to be between 25 and 27 percent higher than the monthly earnings of women. Even after statistically controlling for skills, education, and work experience, and job traits including occupation, employment-related workers traits, and other demographic traits of workers, these earnings regressions estimated a sizable earnings gender gap in favor of male workers. Further research is needed to understand the factors that underlie this sizable regression-adjusted gender gap in earnings.

Although there were differences in the mean earnings of workers by race-ethnicity, after controlling for literacy/numeracy proficiency, educational attainment, and all other covariates included in the regressions in Table 8, the earnings of Black, Hispanic, Asian, and other race-group workers were not expected to be statistically different from the earnings of White workers. The same findings prevailed in all four full earnings regression models presented in Table 8. These findings indicate that the race-ethnicity-based differences in the monthly earnings of these workers were attributable

to differences in their human capital and employment-related traits, the types of jobs to which they have access, and demographic traits of gender and disability status. After statistically controlling for these traits (by including these traits as covariates in these earnings regressions), the regression-adjusted differences in earnings by race-ethnicity were not statistically significant.

A comparison of the mean monthly earnings of workers included in this study found a difference by the foreign-born status of workers; the earnings of foreign-born workers were 10 percent lower than those of native-born workers. However, each of the four full earnings regression models (presented in Table 8) found no statistically significant difference between the regression-adjusted earnings of native- and foreign-born workers (after statistically controlling for literacy and numeracy proficiency, educational attainment, and all other covariates in these regression models). The coefficient for this variable in all four full earnings regression models was not statistically significant.

Table 8: Percent Change in Expected Monthly Earnings from One-Unit Increase In Predictor Variables in Full Regression Models for 25- to 54-Year-Old Full-Time Employed Workers (Findings for a Subset of Explanatory Variables Measuring Demographic Traits of Workers)

EXPLANATORY VARIABLES	(A) SET A-FULL MODEL 6: STANDARDIZED LITERACY PROFICIENCY SCORE	(B) SET B-FULL MODEL 6: WITH STANDARDIZED NUMERACY PROFICIENCY SCORE	(C) SET C-FULL MODEL 6: WITH LITERACY PROFICIENCY LEVELS	(D) SET D-FULL MODEL 6: WITH NUMERACY PROFICIENCY LEVELS
GENDER (BASE GROUP IS FEMALE)				
MALE	27.4***	25.4***	27.3***	24.7***
RACE-ETHNICITY (BASE GROUP IS WHITE)				
HISPANIC	-3.6	-3.3	-4.1	-3.6
BLACK	-1.7	-0.1	-2.3	-0.8
ASIAN, PACIFIC ISLANDER	7.6	7.3	7.7	7.7
OTHER RACE	-0.9	-0.2	-0.8	0.0
NATIVITY STATUS (BASE GROUP IS NATIVE-BORN)				
FOREIGN-BORN	0.3	-0.9	-0.3	-1.4
DISABILITY STATUS (BASE GROUP IS WORKERS WITHOUT DISABILITIES)				
WITH DISABILITY	-8.1***	-8.5***	-8.5***	-8.7***
R-SQUARED	0.500	0.500	0.501	0.502

Statistical significance: *** sig. at .01 level.
Explanatory variables in full regression model (Model 6): Literacy/Numeracy proficiencies; educational attainment; paid work experience, English writing ability sector of employment, occupation, weekly hours of work, school enrollment status, region of residence, gender, race-ethnicity, foreign-born status, and disability status.
Source: 2012 and 2014 PIAAC surveys, restricted use files, tabulations by authors.

The disability status of workers is closely related to their labor market outcomes.[57] Workers with disabilities are less likely to participate in the labor market compared to workers without disabilities. And, when they participate in the labor market, workers with disabilities are less likely to find a job and more likely to remain unemployed than workers without disabilities. Individuals with disabilities have lower labor force participation rates, lower employment rates, and higher unemployment rates

than individuals without disabilities. Even when employed, workers with disabilities work fewer hours per week and fewer weeks per year than workers without disabilities. Our descriptive analysis of PIAAC data found that the mean monthly earnings of 25- to 54-year-old full-time employed workers with disabilities were 21 percent lower than the earnings of workers without disabilities. Even after controlling for skills, education, occupation, and all other covariates included in the four full models of earnings regressions presented in Table 5, the earnings of workers with disabilities were expected to be between 8.1 and 8.7 percent lower than the earnings of workers without disabilities. The coefficient was statistically significant at the .01 level in all four regression models (Table 8).

Some Implications of the Findings

The impact of postsecondary education is often viewed as universally positive. Yet postsecondary education is a label attached to a wide variety of educational outcomes, including some college education without a credential. Our analysis of PIAAC data reveals a troubling problem among prime-age, full-time employed workers who enroll in college but leave before earning a bachelor's degree. We found no earnings advantage (relative to high school graduates) among prime-age, full-time workers who had completed some college education but had not earned any postsecondary credentials as well as among those who had earned a postsecondary certificate.

On average during 2015-2016, nearly 16 million prime-age, full-time workers had completed some college without earning a college degree—about one-sixth of the entire prime-age, full-time workforce of the nation. College enrollment and education for these individuals had no earnings payoff. More surprisingly, we also found no independent (regression-adjusted) earnings premium for those with an associate's degree after accounting for skills, work experience, and personal characteristics.

Among prime-age, full-time workers—who constitute the core of the American labor market—the earnings benefits of enrolling in college seem to occur only at the bachelor's degree level. For millions of prime-age, full-time workers who enrolled in college and completed less than a bachelor's degree education, our analysis found no earnings advantage.

These findings pose serious questions about a human capital development strategy that college enrollment should be the objective for every high school student. We find that for the core of the American workforce—prime-age, full-time workers—the payoff to a college education occurs only when a bachelor's degree is earned. Unfortunately, large shares of students who begin college end up leaving before earning a postsecondary credential. Only one in five degree-seeking students who had enrolled for the first time and full-time in 2011 at a community college had graduated with a certificate or associate's degree within three years (150 percent of normal time). The six-year graduation rate (150 percent of normal time) of first-time, full-time degree/certificate-seeking students who had enrolled at four-year institutions in 2007 was 59 percent.[58]

For prime-age, full-time workers, postsecondary education below the bachelor's degree award level is associated with no independent (regression-adjusted) earnings benefits—despite potentially large costs to both individual college consumers (students) and taxpayers. Given the lack of an earnings payoff for an incomplete postsecondary education, does it make economic sense to send large numbers of teens and young adults into the postsecondary system where many will not earn any degree or certificate award?

While efforts to improve college retention and completion are laudable, many of the factors that exert an influence on college retention, including academic ability and character traits, are developed at the elementary and secondary school level. The postsecondary education system does not seem to be an effective second-chance option for those who exit high school without the proficiencies needed to complete college.

Analysis of the skills of prime-age, full-time workers in this study reveals that even among workers with a bachelor's or higher college degree, sizable shares of these college graduates lacked the minimum level of literacy and numeracy proficiencies that are considered a requirement to function in the job market and daily life.

Many young college graduates also struggle to find employment in college level jobs after completing their bachelor's degree. A recent survey of employers found that "... high employee turnover is the result of workers feeling overqualified for their beginning roles."[59] Moreover, college graduates who fail to find work in jobs that utilize the abilities and knowledge thought to be developed in a four-year college have annual earnings well below their counterparts who work in college labor market occupations.[60]

More significantly, our findings highlight the central role that basic skills proficiencies play in influencing job market outcomes. The earnings of prime-age, full-time workers at every level of education increased with higher levels of literacy and numeracy proficiencies. As Kirsch, Braun, Lennon, and Sands observed, "The multiplicative effects of initial and ongoing differences in opportunity result in widening gaps and increasing inequality in adult outcomes."[61] Failure to develop strong reading, writing, and math skills in elementary and secondary school substantially inhibits access to a college degree and thus the potential development of specific kinds of knowledge associated with these degrees that are highly valued in the labor market.[62] However, even after accounting for literacy and numeracy proficiencies, we find large and statistically significant gains to earning a bachelor's and advanced college degrees. But the pathway to completing these degrees has many "gates," including one of basic skills proficiencies. Henry Braun observed that, "From birth to, say, age 25, individuals accumulate the human capital ... that will play a critical role in their adult outcomes. ... At each stage of development, the gates represent access or obstacles to opportunities to add human capital, *building on whatever potential individuals may have, as well as the human capital they already possess*" (emphasis added).[63]

Opening the pathway to job market success requires the development of basic skills proficiencies. At every level of educational attainment, we find that prime-age, full-time workers with higher literacy and numeracy proficiencies have higher earnings. We also find that earning a bachelor's degree or higher level of education yields large earnings advantages, but the ability to progress along that educational pathway to successful completion is dependent on academic achievement built on the bedrock of literacy and numeracy proficiencies.

Appendices

The appendices to this report can be found online. Please visit https://www.ets.org/research/report/earnings-full-time-labor-market/.

Endnotes

1 *The Human Capital Report, 2015,* World Economic Forum, Employment, Skills, and Human Capital Global Challenge Insight Report, 2015, http://www3.weforum.org/docs/WEF_Human_Capital_Report_2015.pdf (PDF).

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48 The dependent variable in these regressions is the log of the monthly earnings. The anti-log of predictor variables minus 1 provides a measure of the expected percent change in dependent variable (monthly earnings) from a one-unit change in predictor variables. The coefficient for standardized literacy score was .277. The anti-log of .277 = 1.319; and 1.319 - 1 = 31.9 percent.

49 See Box 1 for details.

50 Tables 5 through 8 present (separately) findings for subsets of all explanatory variables included in the full regression Model 6. Findings for all explanatory variables included in the full regression Model 6 are presented (together) in Appendix E.

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