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Examining the Ways that Numeracy Skills and Soft Skills are Related to Occupational Status: The Case of U.S. Workers

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Examining the Ways that Numeracy Skills and Soft Skills are Related to Occupational Status: The Case of U.S. Workers

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Abstract

Policymakers are increasingly concerned that employees need both foundational skills, such as numeracy, and soft skills to be successful in the 21st century economy. However, there is little empirical research that examines whether foundational skills and soft skills have independent or interactive relationships with occupational outcomes. Based on our analysis of PIAAC data, we find that four self-reported measures of the use of soft skills at work have statistically significant, positive relationships with an employee's occupational status—and that these relationships are independent of numeracy skill. The soft skills measures that are positively correlated with occupational status are (a) Readiness to Learn; (b) Influence; (c) Planning; and (d) Task Discretion. We also estimate interaction effects between numeracy skill proficiency and all four aspects of soft skills. Result indicate that the relationships between occupational status and two soft skill types (planning and influence) are significantly different between workers with low and high numeracy proficiency. That is, workers with low-numeracy skills tend to benefit more from exercising planning or influence skills at work than workers with high numeracy proficiency. Independent of soft skills, workers with higher levels of numeracy skills also tend to have higher occupational status.

Examining the Ways that Numeracy Skills and Soft Skills are Related to Occupational Status: The Case of U.S. Workers[2]

> The shift and the transition to an increasingly service-based economy have led to working environments that require more and more collaboration rather than the performance of repetitive tasks or the operation of machinery. Thus, we have seen the rise in both the necessity of and demand for so-called "soft" skills. (p. 4)
>
> - *Closing the Skills Gap: Companies and Colleges Collaborating for Change*

In 2014, the Lumina Foundation sponsored a study by The Economist Intelligence Unit, which examined the current "skills gap" in the U.S. labor market. The report cited survey data from nearly 350 business executives about the kinds of skills that companies look for among potential and current employees. Not surprisingly, one key finding in the report was that employers valued "strong 'foundational skills', such as applied mathematics and reading" (The Economist Intelligence Unit, 2014, p. 6). However, 63% of employers were also looking for soft skills such as collaboration and teamwork; 54% of employers ranked communication as one of the top three needed skills; and 48% of employers stated that they were looking for "adaptability and the managing of multiple priorities" (The Economist Intelligence Unit, 2014, p. 6). Employers are sending a strong message: workers need both 'foundational' skills, such as numeracy, *and* soft skills to be successful in the 21st century labor market.

The Lumina-sponsored report highlighted the demand for skills among certain employers, but it did not set out to measure workers' skills or their use of skills at work. Additionally, the report did not clarify whether employers expect similar use of soft skills among different types of employees in their organizations. In other words, it is unclear whether higher-

[2] We thank Katie Herz, Saida Mamedova, Jaleh Soroui, Emily Pawlowski, and the PIAAC research team (as well as anonymous reviewers) at the American Institutes for Research for their timely communication and helpful comments throughout the process of writing this report.

status workers (e.g., professionals) may use soft skills more often than lower-status (e.g., entry-level) workers. It is also unclear whether there are interaction effects between "foundational skills" and soft skills. It may be that employees with lower numeracy skills may need to use soft skills more frequently to attain higher-status jobs.

In this report, we seek to better understand the relationships between "foundational skills", soft skills, and occupational status among workers in the United States. To this end, we analyze data from the Programme for the International Assessment of Adult Competencies (PIAAC). PIAAC's nationally standardized measures of "foundational skills" (i.e. the numeracy assessment, which is highly correlated with measures from the literacy assessment[3]; see references below to Hanushek, Schwerdt, Wiederhold, & Woessmann, 2015) and soft skills (index measures through self-reported data), offer new opportunities to examine the ways that workers' skills may be related to their job status or prestige. We use economic theory about the returns to skills to address the following research questions:

1. *After controlling for foundational skills as measured by PIAAC's numeracy assessment, are soft skills significantly related with workers' occupational status?*
2. *Are the relationships between soft skills and occupational status different at various levels of proficiency in numeracy?*

The analyses and findings in this report are important because they offer empirical evidence to support policymakers' recent tendency to emphasize the importance of soft skills (European Union's Programme for Employment and Social Solidarity, 2011; OECD, 2012; The Economist Intelligence Unit, 2014). Policy reports in the United States and Europe signal a shift

[3] We want to thank OECD PIAAC analyst Marco Paccagnella for pointing us to note the dependency between literacy and numeracy and how these two domains of skills might be affected differently by the test language.

toward interest in soft skills, yet those reports tend to be based on anecdotes or surveys of employers. This study confirms that there are statistically significant relationships between self-reported use of soft skills at work and occupational status. Additionally, this report offers important insights for policymakers and researchers in that it identifies four types of soft skills and indicates that they have different estimated effects on occupational status. For example, when all four measures of the use of soft skills at work were entered in a single regression model, only two were independently correlated with occupational status. Finally, when we addressed the second research question, we showed that two types of soft skills may be particularly important among workers with low numeracy proficiency. Some scholars have lamented that schools are too focused on teaching basic skills like numeracy and underappreciate the other types of learning that are important for students and workers (e.g., Labaree, 2014; Osher et al., 2016). Taken together, our findings suggest that formal and continuing educational programs should emphasize both "foundational skills" and soft skills because U.S. workers need both in their jobs.

Policy Context

Educational attainment has traditionally been a proxy for human capital and workers' skills. However, even among college graduates, policymakers have expressed concern about whether workers possess the skills that are needed in an increasingly global, high-tech economy. In this context, U.S. and international leaders are focusing on soft skills, in additional to traditional skills such as numeracy. For example, the Organisation for Economic Co-operation and Development (OECD) Skills Strategy shifts the focus from "traditional proxies of skills, such as years of formal education and training or qualifications/diplomas attained, to a much broader perspective" with a heavy emphasis on soft skills (OECD, 2012, p. 12). Additionally, a

series of studies in the European Union projected that by 2020 soft skills and transferable skills such as “flexibility,” “communication,” and “e-skills” would be in high demand across a series of industries (Balcar, 2011).

In the United States, a consortium including The Conference Board, Corporate Voices for Working Families, The Partnership for 21st Century Skills, and The Society for Human Resource Management, surveyed more than 400 employers to identify the different skill sets that employers require and look for in their employees. The consortium found that “a combination of basic knowledge and applied [soft] skills are perceived to be critical for new entrants’ success in the 21st century U.S. workforce” (2006, p. 10). Because U.S. higher education is relatively decentralized, non-governmental and non-university actors are important in determining how colleges and universities may teach and assess soft skills. In recent years, the American Association to Advance Collegiate Schools of Business has adopted accreditation standards that charge accounting and information technology baccalaureate programs with teaching soft skills such as “communication abilities” and “reflective thinking skills” that fall outside technical competencies or foundational skills (Beard, Schwieger, & Surendran, 2008). Beard and colleagues (2008) justified their new curriculum and certification standards by summarizing a 2004 study that found that more than one-quarter of job announcements in information technology fields called for candidates with non-technical skills such as leadership, organization, and self-motivation (see Gallivan, Truex, & Kvasny, 2004).

Although American and European policymakers seem to recognize the importance of soft skills, there is a need for additional empirical research that examines whether there are positive relationships between soft skills and occupational outcomes. Policy documents tend to acknowledge that workers and employers need a balance of foundational skills, such as

numeracy, and soft skills. However, there is little research that tests whether numeracy and soft skills have independent effects on the types of jobs that workers hold or whether the relationships between soft skills and occupational outcomes may be different for workers with high numeracy skills, compared to workers with lower numeracy skills.

Review of the Literature on Soft Skills

In addition to foundational skills, this report focuses on the relationships between occupational status and soft skills, which have been variously referred to as: *noncognitive skills*, *personality traits*, *socialization*, and *social skills* (Beard et al., 2008; Bowles &Gintis, 2002; Cawley, Heckman, &Vytlacil, 2001; Heckman &Kautz, 2012; Heckman & Rubinstein, 2001; Laker & Powell, 2011; Lucs, 2014; Nickson, Warhurst, Commander, Hurrell, & Cullen, 2012). The idea of soft skills comes out of economic theories of human capital (Becker, 1964; Heckman & Rubinstein, 2001; Heckman, Stixrud, & Urza, 2006). Compared to other skill sets, such as numeracy, soft skills may be called "soft" because they are notoriously difficult to measure (Balcar, 2014). The subsections that follow describe the importance of foundational skills, such as numeracy, and the ways that soft skills may complement foundational skills.

The Importance, Measurement, and Limitations of Foundational Skills

Heckman and Rubinstein (2001) recounted that, historically, economics literature has focused on foundational skills. Even though human capital theory[4] and signaling theory[5] have often been seen as different by education researchers and sociologists, Heckman and Rubinstein argued that both schools of thought were fundamentally about how foundational skills were rewarded by employers. Economists have also shown that numeracy scores are a valid measure of foundational skills or human capital apart from formal education (e.g., Murnane, Willett, &

[4] See e.g., Becker (1964)
[5] See e.g., Spence (1974)

Levy, 1995). Moreover, research indicates that foundational skills became more important for workers' occupational outcomes over time in the U.S. (e.g., Murnane et al., 1995). In particular, Murnane et al. (1995) study drew data from two cohort studies (i.e. the National Longitudinal Study of the High School Class of 1972 and High School and Beyond) and suggests that numeracy skills were more important predictors of wage six years after high school in the mid-1980s than in the late 1970s. Moreover, this study also shows that numeracy skills have a larger impact on individuals six years after graduation than on wages two years after graduation.

The PIAAC data has been explored to examine foundational skills distributions and relationships between foundational skill and wages across countries (Hanushek et al., 2015, 2017; Paccagnella, 2015). Although both literacy and numeracy skills were used in the analysis, Hanushek and colleagues (2015; 2017) showed that the PIAAC numeracy measure might be a more precise measure of foundational skills because of its stronger relationship with wages than literacy. Moreover, studies have also showed more dispersed distributions of numeracy skills than literacy skills both within and across PIAAC participating countries (Paccagnella, 2015; Liu, forthcoming). Our analysis chose to use PIAAC numeracy not only because of the argument of it being a more accurate measure of foundational skills, but also due to its relationship with literacy. First, tested numeracy also captures literacy skills as some reading and comprehension of text is usually required to answer numeracy test items (Gal, 2016). Second, international large-scale assessments such as PIAAC is administered in a given language, and it is usually not possible to separate out the cognitive ability from the proficiency in the test language (OECD, 2013a). Therefore, to some extent, numeracy better captures the foundational skills since numeracy items rely less on the proficiency in the language of the assessment.

Although literature suggests that numeracy is a strong measure of workers' foundational skills, economists also point to the need to examine complementary "noncognitive" skills (referred to here as "soft" skills). For instance, Heckman and Rubinstein (2001) used scores from the General Educational Development (GED) test—an alternative credential to the high school diploma—and the Armed Forces Qualifying Test (AFQT) to show that both foundational skills and "noncognitive" skills affect employment outcomes in the U.S. Later work tested various measures of foundational and soft skills and demonstrated that both skill types are independently related to economic and social outcomes (e.g., Heckman & Kautz, 2012; Heckman et al., 2006). The next subsection discusses the literature on soft skills and their importance in understanding outcomes for U.S. workers.

Demand and Benefits of Soft Skills

Soft skills have been defined as the habits, attitudes, and routines that workers use in their jobs and which may lead to higher wages. Soft skills are not only different from foundational skills such as literacy, they can also be explained in contrast with technical skills, such as surgical skills, which are useful in specific tasks and are often the result of formal training programs in applied contexts (Balcar, 2014). The issue of transferability across tasks is one of the most defining—and for policymakers appealing—aspects of soft skills. Soft skills are related to a recent emphasis in the literature on social and emotional learning in the United States, which emphasizes "self-awareness, self-management, social awareness, relationship skills, and responsible decision making" (Osher, Bear, Sprague, & Doyle, 2010, p. 50; see also, Osher et al., 2016).

Borghans, terWeel, and Weinberg (2006) conducted a series of econometric analyses and concluded that soft skills became increasingly important during the latter half of the twentieth

century. As suggested by previously cited policy reports, academic research has confirmed that new jobs tend to require both foundational and soft skills (Bacolod & Blum, 2005; Weinberger, 2011). Brungardt (2011) explained that because of "the *flattening* of the organizational hierarchy, workers at all levels are now required to be proficient in these soft skills [emphasis in original]" (p. 2). Technical skills are necessary for workers to get jobs, but they may not be sufficient for workers to move beyond entry-level jobs or enter professional fields. Instead, Laker and Powell (2011) theorize that "subsequent success beyond these initial levels usually requires proficiency in soft-skill areas: leadership, self-management, conflict resolution, communication, emotional intelligence, and so on. . ." (p. 113).

Laker and Powell (2011) suggest that the use of soft skills at work may be positively related to worker's occupational status (i.e., whether they work in entry-level or higher status positions). Other literature also suggests that the use of soft skills may be correlated with occupational status. For example, Lucs (2014) argued that professionals who cultivate soft skills take different approaches to job searches and contract negotiations that may help them secure better jobs in a competitive labor market. There is some evidence that employers are not only looking for workers who can use soft skills in their jobs, they are also paying higher wages to workers for soft skills (e.g., Bacolod & Blum, 2005; Heckman et al., 2006). However, to the best of our knowledge, researchers have not directly tested whether there are statistically significant relationships between soft skills and holistic measures of employees' occupational status.

Theoretical Framework: Returns to Skills

This study uses a human capital framework to inform our analysis and the interpretation of our findings (e.g., Becker, 1964; Hanushek et al.,2015; Heckman & Rubinstein, 2001;

Heckman, et al., 2006). Human capital theory suggests that workers who have higher skills or who use skills more often in their jobs tend to have more lucrative occupational outcomes. Additionally, recent advances in human capital theory suggest that we can distinguish between different types of skills or capital. For example, Heckman, Stixrud, and Urzua (2006) found that soft skills are positively related to employees' wages. Furthermore, soft skills were "about equally strong in many outcomes and . . . stronger for some outcomes" when compared to various measures of foundational skills, including arithmetic reasoning and mathematical knowledge (Heckman, et al., 2006, p. 478).

Human capital theory also suggests that educational attainment is a proxy for the skills that a worker may offer an employer. One of the advantages of the PIAAC data is that it allows us to measure worker skills directly, rather than use educational attainment proxies. As previously discussed, policymakers are also interested in expanding the scope of discussion beyond "traditional proxies of skills, such as years of formal education and training or qualifications/diplomas attained" and to emphasize direct relationships between skills and jobs (OECD, 2012, p. 12). Thus, based on human capital theory, we conduct our analyses using direct measures of foundational skill ability rather than educational attainment variables.

When we interpret results, we also draw upon human capital theory to make sense of any positive relationships between skill variables and occupational outcomes. We do not seek to make any causal arguments about whether workers are promoted because they have higher levels of innate soft skills. However, human capital theory suggests that there are positive relationships between various types of employees' skills (or use of skills) and the types of jobs that workers hold in society. Thus, in the context of this paper, we interpret positive relationships between the

use of soft skills and occupational status as representing rewards that employers offer in exchange for human capital.

Sample

Data from the U.S. are used for this study. The sample is limited to prime-age workers between the ages of 30 and 59; that is we removed PIAAC participants who were fewer than 30 years of age and 60 years old or older (N =1827). Prime age workers are most likely to have completed formal schooling and to have enough time for allow the relationship between soft skills and occupation to fully develop. Additionally, we exclude workers who worked in the armed forces (N = 2) because jobs in the armed services may be of a sufficiently different nature than careers in other occupational fields such as different opportunities for mobility and management. There are 1485 participants in the entire sample whose occupation codes are missing, including those who were not employed at the time of interviews and therefore were not routed to the corresponding questions related to current occupation. T-tests indicate that there are statistically significant differences between respondents who were missing occupation codes and respondents who had occupation codes in whether they had a parent who was a college graduate, readiness to learn, and planning skills. In the rest of the covariates, including age, immigration status, influence and task discretion skills, there were not statistically significant differences between respondents with and without occupational status data. Due to the fact that occupational status is the main outcome being examined, the analysis excludes individuals without occupation code. These limitations decrease the size of the sample from approximately 5,000 respondents to 2,300 respondents.

Data and Methods

We analyze data from the Programme for the International Assessment of Adult Competencies (PIAAC) to address our research questions: *After controlling for foundational skills as measured by PIAAC's numeracy assessment, are soft skills significantly related with workers' occupational status? Are the relationships between soft skills and occupational status different at various levels of proficiency in numeracy?* PIAAC is an ideal dataset because it includes a nationally-representative sample of workers in the United States and measures their numeracy skills as one of its core constructs. Additionally, PIAAC uses survey data to quantify latent constructs of worker's abilities, attitudes, and habits (which we have referred to as "soft skills" throughout this paper). Finally, PIAAC records detailed information about participants' demographic and occupational backgrounds.

We use ordinary least squares (OLS) estimation to analyze PIAAC data. For the first research question, we regress worker's occupational status on their numeracy skills, soft skills, and a vector of control variables (discussed below). For the second research question, we grouped PIAAC respondents by levels of numeracy proficiency and recoded each of the plausible value into a dichotomous variable indicating whether an individual exhibits a high numeracy proficiency. We then used interaction terms to determine whether the relationships between soft skills and occupational status tended to vary among workers with different levels of numeracy skill proficiency. In the subsections that follow, we discuss the variables and analytic process in further detail.

Dependent Variable

The public-use OECD PIAAC data file records workers' occupations using two-digit codes from the International Standard Classification of Occupations (*ISCO2C*). We use

Ganzeboom and Treiman's (2010) International Stratification and Mobility File to generate a new variable that ranks worker's occupations based on occupational status or prestige. The International Stratification and Mobility File provides a crosswalk between two-digit ISCO codes and derived, internationally comparable measures of occupational status. Thus our dependent variable, *Occupational Status*, represents the conversion from PIAAC's *ISCO2C* data to Ganzeboom and Treiman's International Socio-Economic Index of Occupational Status scores. *Occupational Status* is a continuous variable which is commonly used in sociological and economic research (e.g. Blanden, 2013; Breen & Jonsson, 2005).

Measures of occupational status are useful because they are based on the idea that occupations can be compared by more than their levels of compensation (i.e., salaries or wages). Zhou (2005) explains that occupational prestige is one of many "social phenomena that involve processes of intersubjective evaluation" and argues that "prestige, honor, and deference are meaningful and important rewards" (p. 133). Therefore, we use the *Occupational Status* variable because it helps us test the relationships between numeracy and soft skills on a holistic measure of worker's standing in society. For example, financial brokers (67) or finance managers (68) may earn more than assistant professors, but university professors are often seen as having the more prestigious occupation because their positions require formal knowledge or scientific expertise.

The *Occupational Status* variable accounts for differences in prestige apart from earnings. The dependent variable, based on Ganzeboom and Treiman's (2010) scores, minimizes the direct effects of education on earnings but maximizes the indirect effects of education. A typical economic approach (e.g., Mincer equation) regresses a workers' earnings on their years of schooling. However, the benefits of each additional year of education are not

actually linear and may decline (Patrinos, 2016). If status scores were simply a measure of the direct effect of education or human capital on earnings, professors with doctorates would likely have lower occupational status scores than less-educated but better paid professionals. Instead, professors may have higher occupational status scores because the way the scores are calculated (minimizing the direct effect of education on earnings but increasing the indirect effects of education on their occupational status).

The dependent variable measures the ways that education or human capital operates *through* occupations. For example, financial brokers and finance managers have *Occupational Status* scores of 67 and 68, respectively, while university faculty have a score of 76. In our final sample, the minimum *Occupational Status* score was 14 for workers who were employed as "mixed crop growers," and the maximum *Occupational Status* score was 69 for participants who worked as "chief executives, senior officials and legislators."[6] See Table 1 and 2 for descriptive statistics on occupational status by levels of numeracy skills.

Independent Variables

Numeracy skills. PIAAC used computer adaptive testing to assess worker's numeracy skill, which is considered a more accurate measure of human capital than years of schooling (e.g., Hanushek et al., 2015; OECD, 2013a). The conceptualization of PIAAC numeracy test involves a multi-faceted framework with three interlocking elements: a definition of the competency itself, a model describing dimensions and specific facets of 'numerate behavior', and the numeracy complexity scheme. The numeracy competency is defined as "the ability to access, use, interpret and communicate mathematical information and ideas in order to engage in and manage the mathematical demands of a range of situations in adult life" (OECD, 2012).

[6] See http://www.harryganzeboom.nl/isco08/index.htm http://www.harryganzeboom.nl/isco08/isco08_with_isei.pdf

Numerate behavior involves managing a situation or solving a problem in a real context, by responding to mathematical content/information/ideas represented in multiple ways.

Each respondent completed a portion of the numeracy assessment, and PIAAC used item response theory techniques to calculate 10 plausible values of numeracy skill for each respondent (OECD, 2013a). Workers with lower numeracy scores—or levels of proficiency—are able to complete tasks such as counting or adding money. Workers with higher numeracy scores (or levels of proficiency) are able to complete the lower-level tasks as well as solve more complex, often multi-step or abstract, tasks, which may include multiple forms of data (e.g., texts, tables, graphs) or require the use of problem-solving skills. Appendix B provides a more detailed description of numeracy achievement level and score range, and the corresponding task descriptions.

For the first research question, we use all ten plausible value variables (*PVNUM1-PVNUM10*) in our analyses. For the second research question, we recode the raw scores into proficiency levels based according to the U.S. National Center for Education Statistics guidelines (the recoding is further discussed in the Methods of Analysis section below).[7]

Soft skills. PIAAC contains four measures of soft skills, which are derived based on respondents' perceived use of skills at work (see Appendix A for a list of background questionnaire items used to generate each index variable). A careful review of the PIAAC index variables measuring the use of soft skills at work suggested that the variables had construct validity. Shadish, Cook, and Campbell (2002) defined construct validity "as the degree to which inferences are warranted from the observed persons, settings, and cause and effect operations included in a study *to the constructs that these instances might represent*[emphasis added]" (p

[7] See https://nces.ed.gov/surveys/piaac/numproficiencylevel.asp

38). In other words, for policymakers to draw correlational inferences from this study, it is important that the variables and measures included in statistical models approximate or "might represent" the actual use of soft skills as they are defined by policymakers. According to *The Survey of Adult Skills: Reader's Companion* that was published by the OECD, the PIAAC skill use variables are measures of the use of skills at work or task clusters and are based on descriptions of specific types of activities. When we compared the definitions to a timely policy report, we found that the PIAAC measures had construct validity based on the European Union's Programme for Employment and Social Solidarity (EUPESS) definition of soft skills as "non-job specific skills that are related to individual ability to operate effectively in the workplace" (2011, p. 10). More specifically, the EUPESS report classified 22 types of soft skills into five clusters. Based on the definitions and examples in the EUPESS report, the PIAAC variables arguably have construct validity as measures or proxies of three EUPESS soft skill clusters (i.e., Personal Effectiveness Skills, Impact and Influence Skills, and Achievement Skills). See Table 1 below. Also, see Appendix A for a list of the variables or items that were used to create the soft skill index variables.

Table 1: Comparison of PIAAC Variables to Definitions of Soft Skills in the European Union's Programme for Employment and Social Solidarity Report for Purposes of Assessing Construct Validity

Skill Use Indicator or Task Cluster	Variable or Example of Skill	PIAAC Description of component activities for Task Clusters	EUPESS Definition of Skill
PIAAC: Learning at Work EUPESS: Personal Effectiveness Skills	PIAAC: Readiness to Learn EUPESS: Lifelong learning	"Learning new things from supervisors or co-workers; learning by doing; keeping up to date with new products or services." (OECD, 2013b, p. 43)	"These skills reflect some aspects of an individual's maturity in relation to himself/herself, to others and to work. They are related to performance of an individual when dealing with environmental pressures and difficulties." (EUPESS, 2011, p. 10)
PIAAC: Influencing Skills EUPESS: Impact and Influence Skills	PIAAC: Influence EUPESS: Impact/influence skills	"Instructing, teaching or training people; making speeches or presentations; selling products or services; advising people; planning others' activities; persuading or influencing others; negotiating." (OECD, 2013b, p. 43)	"Skills in this cluster reflect an individual's influence on others. Managerial competencies are a special subset of this cluster." (EUPESS, 2011, p. 10)
PIAAC: Organisation and Planning EUPESS: Achievement Skills	PIAAC: Planning EUPESS: Planning and organization; Autonomy	"Planning own activities; planning activities of others; organising own time." (OECD, 2013b, p. 42)	"The essence of this cluster is a tendency towards action, directed more at task accomplishments than impact on other people." (EUPESS, 2011, p. 10)
PIAAC: Task Discretion EUPESS: Achievement Skills	PIAAC: Task Discretion EUPESS: Planning and organization; Autonomy	"Choosing or changing sequence of job tasks, the speed of work, working hours; choosing how to do the job." (OECD, 2013b, p. 43)	

Sources: OECD (2013b). The Survey of Adult Skills: Reader's Companion, Tables 2.5 and 2.6 (pp. 42-43). European Union Programme for Employment and Social Solidarity. (2011). Transferability of skills across economic sectors: Role and importance for employment at European level.

The comparison between PIAAC measures or variables and the EUPESS skill clusters (see Table 1) is important because it not only provides a rationale for examining the relationship between occupational status, numeracy skills, and the use of soft skills at work, but it also opens directions for future research that can compare use of soft skills at work between American and European workers. We use PIAAC's *Readiness to Learn* variable as a measure of EUPESS's example of lifelong learning as a personal effectiveness skill. We also use PIAAC's *Influence* variable as a measure of EUPESS impact and influence skills. Finally, in our analyses, the EUPESS examples of achievement skills (i.e., planning/organization and autonomy) are represented by two PIAAC variables: *Planning* and *Task Discretion*. The variables measure influence with one's coworkers and supervisors (*Influence*), the ability for planning one's activities (*Planning*), whether respondents exercise task discretion in completing one's work (*Task Discretion*), and adults' perceptions of their own attitudes and abilities to acquire new information and skills (*Readiness to Learn*).[8]

The four soft skill variables are derived from responses to items in the background questionnaire using weighted maximum likelihood estimation. The *Task Discretion* variable is based on four items; *Planning* is based on three items; *Influence* is based on seven items; and *Readiness to Learn* is based on six items. The variables represent standardized scale scores, which are standardized to have mean equal to 2 and standard deviation equal to 1 across the pooled sample of respondents in all countries with appropriate weights. According to the PIAAC technical report, this results in indices for which at least 90% of the observations lay between 0 and 4, whereby values approaching 0 suggest a low frequency of use and values approaching 4

[8] In the PIAAC codebook, the variables are named READYTOLEARN, INFLUENCE, PLANNING, and TASKDISC.

suggest a high frequency and individuals who report never performing any of the tasks include in each IRT scales are excluded from these scales (OECD, 2013a)[9].

Control Variables. A vector of variables controls for background characteristics that are related to workers' occupational outcomes. Similar control variables are often used in sociological and economic analyses (e.g., Hanushek et al., 2015; Heckman et al., 2006). We control for respondents' *Age* (measured categorically in ten-year bands), *Immigrant Status* (born in U.S. = 0, immigrant = 1), *Parental Education* (neither parent has a baccalaureate degree = 0, either parent has baccalaureate degree = 1), and whether the respondent is *Female* (male = 0, female = 1).[10]

Prior PIAAC research shows that occupational outcomes tends to be worse among immigrants, workers with less-educated parents, and women (Ford & Umbricht, 2016; Smith & Fernandez, 2015, 2017). The control variables account for potentially confounding factors that may affect the relationship between occupational status, numeracy, and soft skills.

Meanwhile, we are aware that parental education may be acting as a proxy for social capital which might be correlated with soft skills such as ready to learn. Immigration is not a random process and is likely to be correlated with soft skills such as perseverance, and self-directedness. Either case may lead to an underestimation of the correlation between soft skills and occupational status. Table 2 displays the Pearson correlation coefficients for each of the soft skills examined in this study and those two covariates (immigrant status and parental education), and shows that the correlations are small. So in the case of four soft skills being examined in this

[9] Information about how each of these four variables is constructed can be found at https://drive.google.com/file/d/0BzEQhC_zgmmTYlRDU1hYMmc1c0U/view.
[10] In the PIAAC codebook, the control variables are named AGEG5LFS, GENDER_R, J_Q04a, and PARED, respectively.

study, underestimation because of the correlations between these two covariates and soft skills will not be a major concern.

Table 2: Pearson Correlation Coefficients between Parental Education, Immigrant Status, and Soft Skills

	Immigrant	At least one parent has college degree
Readiness to Learn	-0.088	0.120
Influence	-0.071	0.078
Planning	-0.049	0.032
Task Discretion	-0.044	0.067

Methods of Analysis

We use the Stata statistical package (Version 14) to perform OLS estimation to regress *Occupational Status* on *Numeracy*, the four soft skill variables (*Readiness to Learn*, *Influence*, *Planning*, and *Task Discretion*) and the control variables. The OLS models will follow the general form:

$$OccupationalStatus = Y_i = \alpha_i + \beta_1 A_i + \beta_2 F_i + \beta_3 I_i + \beta_4 P_i + \beta_5 N_i + \beta_5 S_i + \varepsilon_i$$

Where A represents the respondent's age in five-year bands; F represents whether the respondent is female; I codes respondents' immigrant status; P represents parental education; N represents numeracy skills; S refers to a vector of the four soft skills; and ε is the error term.

To address the first research question (*After controlling for foundational skills as measured by PIAAC's numeracy assessment, are soft skills significantly related with workers' occupational status?*) we enter sets of variables into the model sequentially to test whether soft skills and numeracy skills are independently related to occupational status. The first model regresses *Occupational Status* on the variables that control for demographic information, including *Age, Female, Immigrant Status,* and *Parental Education,* and the ten *Numeracy*

plausible values to test the relationship between numeracy skill and occupational status, net of the control variables. Next, we enter separately *Readiness to Learn*, *Influence*, *Planning*, and *Task Discretion* to determine whether each of the four aspects of soft skills are statistically significantly related to occupational status after controlling for demographics and numeracy ability. Finally, we allow all four dimensions of soft skills to enter the model to compare the estimated effects of the soft skill variables with the estimated effect of numeracy skill.

We address the second research question (*Are the relationships between soft skills and occupational status different at various levels of proficiency in numeracy?*) by grouping PIAAC respondents according to numeracy proficiency levels and interacting the proficiency level with each of the soft skills separately. We recode each of the Plausible Values into a dichotomous variable indicating a high numeracy proficiency, i.e. pvnumh1 – pvnumh10. Numeracy scores between 0 and 275 (i.e. PIAAC proficiency Below Level 1, Level 1, and Level 2) are combined and referred to as the low numeracy proficiency group, and scores between 276 and 500 (i.e. PIAAC proficiency Level 3, Level 4, and Level 5) are combined and referred to as the high numeracy proficiency group. We then interact each of the four soft skill variables with each of the 10 derived dichotomous variables, and generate 40 interaction terms. Dividing the sample into low and high proficiency groups is primarily out of practical concern. First, it ensures that each numeracy proficiency category has enough observations. Second, given that the regression model relies on the interaction terms to explore whether the estimated effect of the soft skills variables varies among workers with different levels of numeracy proficiency, more than two categories will make interpreting the results not so straightforward.

We then regress occupational status on (a) the control variables and the soft skill variables; (b) the control variables, soft skill variables, dichotomous variables of a high

numeracy proficiency and interaction terms that test whether the estimated effects of the soft skill variables vary by numeracy skill proficiency.

We use the PIAAC sampling[11] and jackknife replicate weights[12] in our analyses to account for the complex sampling design. Additionally, we use ten plausible values of numeracy scores, and analyses are estimated ten times, once for each plausible value, and estimates are combined using Rubin's rule (1987) to provide appropriate standard errors.

Findings

As stated before, we use prime-age workers aged 30 to 59 for the analyses. Table 3 provides the descriptive statistics of the PIAAC numeracy scores[13], occupational status, and four aspects of soft skills for these individuals. The results demonstrate that across three age cohorts, the young cohort (aged 30-39) exhibits the highest level of numeracy skills; yet these differences across three age groups are not statistically significant at the 99 percent confidence interval level, at which all of the analysis in this paper is based on.

The senior cohort (aged 50 – 59) has the highest occupational status, although the differences compared to the other cohorts are not significant. There is no obvious pattern when examining four dimensions of soft skills across these three cohorts. The 30-39-aged workers display the highest level of *Readiness to Learn*, while the 50-59-aged workers have the highest level of *Planning* skills. And the 40-49 age cohort demonstrates the highest levels of *Influence* and *Task Discretion* skills.

[11] In the PIAAC codebook, the final sampling weight variable is named SPFWT0.
[12] In the PIAAC codebook, the replication approach variables are spfwt1to spfwt80.
[13] Stata module *repest* is used in calculating the numeracy scores to take into account complex survey designs of the PIAAC data. A sampling weight is used to calculate all other estimates, account for complex survey designs, and thus adjust for sampling error.

Table 3: Descriptive Statistics of Average Numeracy Scores, Occupational Status, and Soft Skills by Demographic Groups among U.S. Adults Aged 30 – 59

		Numeracy Scores	Occupational Status	Readiness to learn	Influence	Planning	Task Discretion
All	Mean	260.554	46.451	2.489	2.300	2.186	1.954
	Min	51.701	14	-0.620	-0.010	0.117	-0.279
	Max	425.272	69	5.004	5.789	3.823	4.418
Aged 30-39 (33.43%)	Mean	**264.539**	46.102	2.526	2.296	2.125	1.919
	Min	91.039	14	-0.076	0.010	0.117	0.034
	Max	422.304	69	5.004	5.789	3.823	4.418
Aged 40-49 (33.74%)	Mean	**257.720**	46.382	2.499	2.342	2.178	1.984
	Min	54.574	14	-0.536	0.010	0.299	-0.279
	Max	405.782	69	5.004	5.789	3.823	4.418
Aged 50-59 (32.83%)	Mean	**259.521**	46.883	2.439	2.258	2.258	1.959
	Min	69.944	14	-0.620	0.010	0.117	-0.279
	Max	409.187	69	5.004	5.789	3.823	4.418
Male (49.46%)	Mean	266.813	46.545	2.510	2.295	2.228	1.997
	Min	75.987	14	-0.536	0.010	0.117	-0.279
	Max	423.414	69	5.004	5.789	3.823	4.418
Female (50.54%)	Mean	253.811	46.348	2.466	2.305	2.142	1.909
	Min	55.635	14	-0.620	-0.010	0.117	-0.279
	Max	401.646	69	5.004	5.789	3.823	4.418
Native born (84.64%)	Mean	267.317	47.335	2.562	2.359	2.224	1.983
	Min	65.710	14	-0.620	0.010	0.117	-0.279
	Max	425.272	69	5.004	5.789	3.823	4.418
Immigrants (15.36%)	Mean	228.572	42.092	2.159	1.974	1.989	1.794
	Min	58.791	14	-0.536	-0.010	0.117	-0.279
	Max	398.399	69	5.004	5.789	3.823	4.418
With college graduate parents (38.70%)	Mean	282.682	52.182	2.625	2.470	2.300	2.062
	Min	106.948	14	-0.536	0.010	0.117	-0.279
	Max	412.862	69	5.004	5.789	3.823	4.418
No college graduate parents (61.30%)	Mean	250.241	43.571	2.420	2.206	2.128	1.897
	Min	57.110	14	-0.620	-0.010	0.117	-0.279
	Max	423.584	69	5.004	5.789	3.823	4.418

Source: Authors' calculations based on the Survey of Adult Skills (PIAAC), 2012.

Table 3 also indicates gender disparities, with male workers exhibit higher level of numeracy proficiency and higher occupational status than female workers. Female only

demonstrates higher level of *Planning* skills than male concerning the four aspects of soft skills. Workers who were born in the U.S. exceed immigrants in both foundational and soft skill measures and have higher occupational status. Individuals with at least one college graduate parent also exceed those who do not have any college graduate parent in the skill areas.

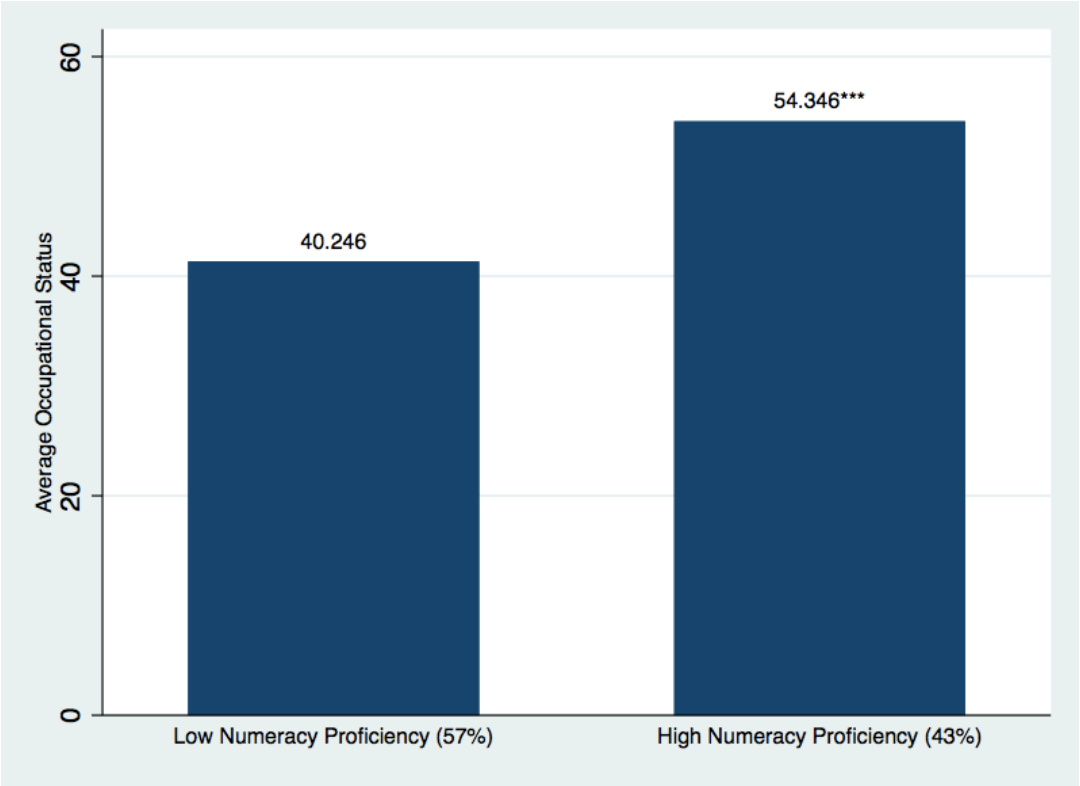
Table 4: Occupational Status and Soft Skills by Numeracy Proficiency Level

Numeracy Level	Percentage	Occupational Status	Readiness to learn	Influence	Planning	Task Discretion
Low Numeracy Proficiency	57% (0.011)	40.246 (0.437)	2.332 (0.032)	2.162 (0.035)	2.051 (0.037)	1.876 (0.030)
High Numeracy Proficiency	43% (0.011)	54.346*** (0.460)	2.648*** (0.032)	2.488*** (0.033)	2.409*** (0.036)	2.176*** (0.031)

Note: Within each cell, the number on the top indicates the mean, and the bottom number being the standard errors. The difference in Occupational status and soft skills between low and high numeracy proficiency group is significant at 99 percent confidence interval. Numeracy scores between 0 and 275 are identified as low proficiency, between 276 and 500 are high proficiency.

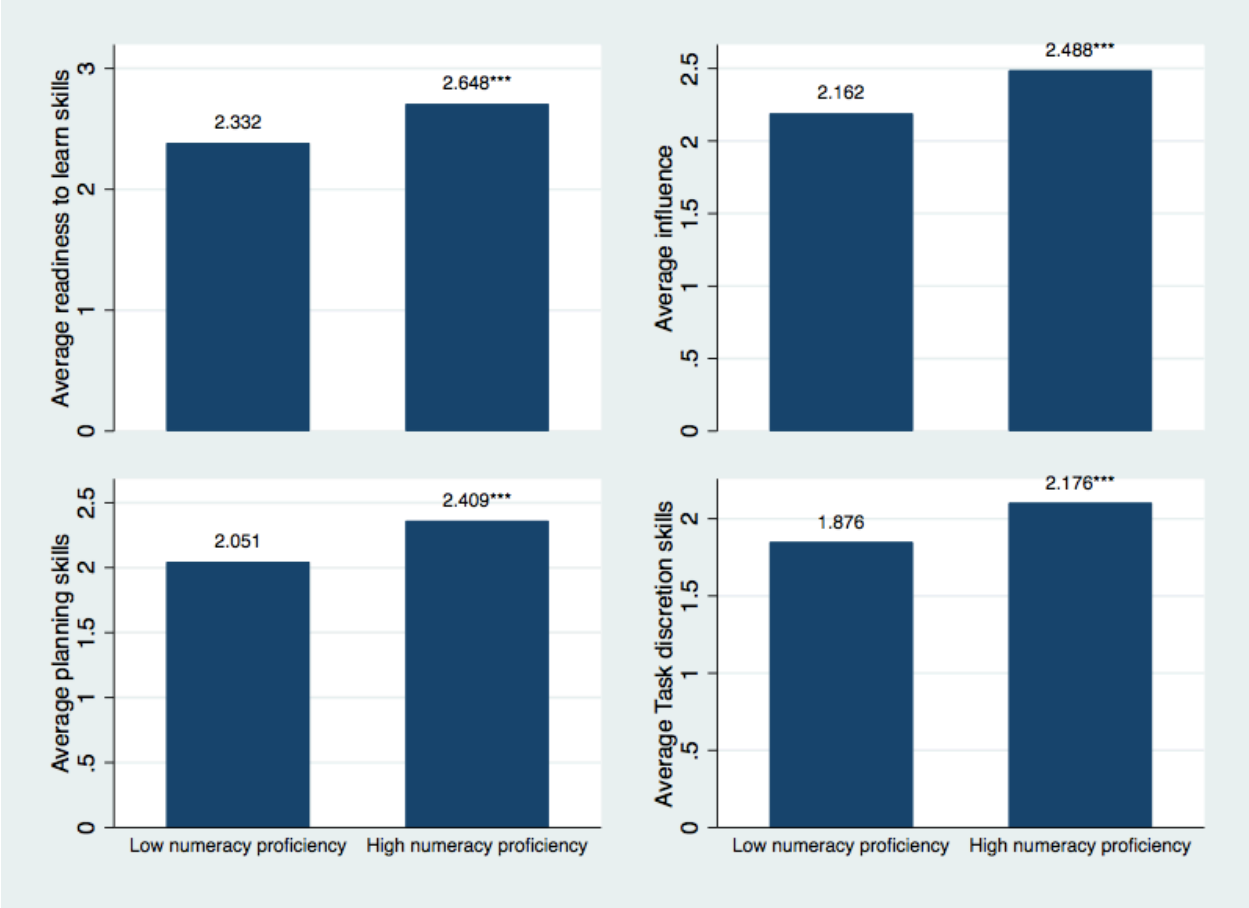
Table 4 provides summary statistics of occupational status, and soft skills by numeracy proficiency level. These results reveal that individuals with high numeracy proficiency also have higher occupational status, and higher level of soft skills in all four dimensions. The same relationships are displayed graphically in Figure 1 and 2 as shown below.

Figure 1: Average occupational status among U.S. employed adults aged 30-59, by numeracy proficiency level



Note: Low numeracy proficiency indicates PIAAC numeracy score is below 276, and high numeracy proficiency suggests the score is between 276 and 500. The asterisks indicate the group means are significantly different from each other at 99.9% confidence level.

Figure 2: Average soft skills among U.S. employed adults, by numeracy proficiency level



Note: Low numeracy proficiency indicates PIAAC numeracy score is below 276, and high numeracy proficiency suggests the score is between 276 and 500. The asterisks indicate the group means are significantly different from each other at 99.9% confidence level.

Estimates from Regression Analyses

We used OLS regression to answer the first research question (*After controlling for foundational skills as measured by PIAAC's numeracy assessment, are soft skills significantly related with workers' occupational status?*). Table 5 displays results from five different regression models, with the first four regressing occupational status on numeracy skills and one of each of the four soft skills, along with the control variables. The last column contains results with all four soft skills entered the model, along with numeracy scores and other control variables. Overall, numeracy scores are positively associated with occupational status. A unit

increase in numeracy score (ranging from 0 to 500) is associated with 0.12 to 0.13 units increase in *occupational status* (ranging from 14 to 69). Putting it differently, two standard deviations increase in numeracy scores (about 115 score points for 2 standard deviations of numeracy scores) is associated with one standard deviation increase in *Occupational Status* (about 15.9 points).

When the soft skill variables are entered separately in the first four models, each of the four soft skills displays a significant positive relationship with *Occupational Status*. However, only *Influence* remains significantly positive in the full model containing all four soft skills. Specifically, *Influence* was estimated as having the largest independent relationship with *Occupational Status* after controlling for other soft skill, numeracy, and control variables[14]. A unit increase in *Influence* is associated with 2.7 units increase in *Occupational Status*. This translate into a six standard deviation increase in *Influence* (a standard deviation is about 1.07) being associated with one standard deviation increase in *Occupational Status*.

It is worth noting a few findings related to the control variables in the full regression model. Although on average women have lower occupational status than men, after controlling for other background characteristics, the disadvantage of being a female worker is not significant any more. Having at least one college graduate parent is associated with 3.8 units higher in occupational status. It is to say that having a college graduate parent is associated with a quarter standard deviation of occupational status. The effect of having a college graduate parent on *Occupational Status* therefore is equivalent to half a standard deviation increase in numeracy scores and 1.25 standard deviation increases in *Influence* scores.

[14] We conducted a z-test of the four coefficients of soft skills when each of the four soft skills entered the model individually, and t-tests for the full model containing all four soft skills. In both cases, the largest independent relationship between *Influence* and *Occupational Status* is significant.

Table 5: Regression Results - Occupational Status, Soft skills, and Numeracy Scores

	Model 1 (Readiness to Learn)	Model 2 (Influence)	Model 3 (Planning)	Model 4 (Task Discretion)	Model 5 (All Soft Skills)
Numeracy	0.124***	0.114***	0.121***	0.122***	0.116***
	0.006	0.006	0.007	0.007	0.007
Female	1.345	1.318	1.421	1.457	1.624
	0.58	0.598	0.654	0.596	0.676
Immigrants	0.651	2.034**	0.366	0.595	1.619
	1.011	1.028	0.997	0.984	1.086
College parent	4.614***	4.052***	4.011***	4.416***	3.787***
	0.761	0.733	0.809	0.776	0.776
Aged 40-49	1.250	1.317	0.835	1.168	1.072
	0.729	0.765	0.823	0.784	0.834
Aged 50-59	1.943***	2.060***	1.152	1.711***	1.668
	0.596	0.636	0.679	0.557	0.715
Readiness to Learn (ranging from -0.62 to 5.004)	1.335***				0.439
	0.338				0.339
Influence (ranging from -0.01 to 5.789)		3.424***			2.744***
		0.368			0.457
Planning (ranging from 0.117 to 3.823)			2.238***		0.367
			0.339		0.414
Task Discretion (ranging from 0.279 to 4.418)				2.081***	0.918
				0.42	0.469
Constant	7.370***	5.785***	7.798***	7.358***	3.720
	1.925	1.788	1.942	1.867	2.235
R^2	0.229	0.275	0.253	0.240	0.272

Note: Standard errors displayed as the bottom number in each cell, *** p<0.01, ** p<0.05, * p<0.1.

Table 6 displays four sets of regression results that address our second research question (*Are the relationships between soft skills and occupational status different at various levels of proficiency in numeracy?*). Each column reports estimates from a model that regresses *Occupational Status* on demographic characteristics, one of the four soft skill variables, a

dichotomous variable indicating high numeracy proficiency (with 10 plausible values), and 10 interaction terms between each of the ten dichotomous variables indicating high numeracy proficiency and the soft skill for that model. Results show that both high numeracy and each of the soft skills remain strong predictors of worker's occupational status.

However, as far as readiness to learn, and task discretion skills are concerned, they do not have varying relationships for workers with different levels of numeracy skills when it comes to occupational status. In other words, the two variables that represent the use of readiness to learn, and task discretion skills at work are independently associated with occupational status; these variables do not change the relationship between numeracy skill and workers' occupational prestige or status.

However, the interaction terms between a high level of numeracy proficiency and two other aspects of soft skills – influencing and planning skills are significantly negative at 95% confidence interval. As mentioned before, the relationships explored here are not causal and can only be interpreted as correlational. The negative coefficient for the interaction term between high numeracy proficiency and influencing or planning skills indicates a negative relationship between influencing or planning skills and the marginal return of high proficiency on occupational status. Alternatively, the relationship between one of these two soft skills and the marginal return of low proficiency on occupational status is positive. This implies that even if someone has a low numeracy proficiency, if they exercise planning or influencing skills more often, their occupational status could be quite high.

Table 6: OLS Regression Results - Occupational Status, Soft skills, Numeracy Scores, and Interacting Numeracy Proficiency Levels and Soft Skills

	Model 1 (Readiness to Learn)	Model 2 (Influence)	Model 3 (Planning)	Model 4 (Task Discretion)
Female	0.773	0.867	0.830	0.861
	(0.611)	(0.628)	(0.696)	(0.620)
Immigrants	-1.555	0.298	-1.257	-1.680
	(1.050)	(1.061)	(1.032)	(1.060)
College Parent	5.513***	4.786***	4.826***	5.291***
	(0.786)	(0.760)	(0.830)	(0.807)
Aged 40-49	1.115	1.174	0.609	0.952
	(0.743)	(0.800)	(0.849)	(0.794)
Aged 50-59	1.899***	1.933***	0.990	1.599***
	(0.648)	(0.665)	(0.727)	(0.600)
High numeracy proficiency	13.438***	14.003***	14.768***	12.702***
	(1.917)	(1.580)	(1.722)	(1.929)
Readiness to Learn (ranging from -0.62 to 5.004)	1.963***			
	(0.461)			
Readiness to Learn * high numeracy	-0.859			
	(0.661)			
Influence (ranging from -0.01 to 5.789)		4.364***		
		(0.477)		
Influence * high numeracy		-1.546**		
		(0.648)		
Planning (ranging from 0.117 to 3.823)			3.125***	
			(0.474)	
Planning * high numeracy			-1.822**	
			(0.737)	
Task Discretion (ranging from 0.279 to 4.418)				2.619***
				(0.606)
Task Discretion * high numeracy				-0.838
				(0.825)
Constant	33.865***	29.660***	33.774***	34.054***
	(1.496)	(1.304)	(1.268)	(1.369)
R^2	0.193	0.242	0.218	0.204

Note: Each of the four models corresponds to each of the four soft skills and the interaction term between each soft skill and its interaction with a high numeracy indicator. Standard errors displayed as the bottom number in each cell, *** p<0.01.

Discussion

This paper sets out to examine the relationship between numeracy skills, use of soft skills at work, and occupational status after controlling for multiple background characteristics among American prime-age workers. The study was motivated by discussions of soft skills both in the policy realm and among empirical researchers. In particular, we explored whether soft skills were independently related with occupational status and whether including measures of the use of soft skills changed the statistical relationship between foundational skills and occupational status. Our findings are consistent with prior literature and the human capital interpretation of skills. Both foundational skills as measured by PIAAC numeracy scores and each of the four aspects of soft skills explored in the study are positively related to occupational status and appear to be rewarded in the labor market. As our results suggest, four self-reported measures of the use of soft skills at work have statistically significant, positive relationships with an employee's occupational status—and these relationships are independent of numeracy skill. The soft skills measures that are positively related with occupational status are (a) Readiness to Learn; (b) Influence; (c) Planning; and (d) Task Discretion. When including all four soft skills in the model, the use of influence skills remains statistically significant.

With the available data set, we could not detangle whether it is the supply side or the demand side of soft skills that drives this relationship. It could be the case that employees who possess high level of soft skills are more likely to obtain positions with high job prestige. Alternately, positions that come with high job prestige allow employees to frequently exercise

soft skills such as influencing, planning, etc. Future research may examine causal effects and the directionality of the relationships between soft skills and occupational status.

As discussed in the introduction, policymakers suggest that it is not enough to consider numeracy and soft skills as separate domains; instead, employers are interested in the ways that employees may need and use the two types of skills within the same job or organization. However, even though the human resources community has acknowledged the importance of soft skills, Laker and Powell (2011) estimated that more than 85% of training focused on improving technical skills as opposed to soft skills. Policymakers and educators often disproportionately focus on developing foundational skills, such as numeracy or literacy. However, as mentioned at the beginning of the paper, civil society (foundations and international organizations) are calling for increased attention to soft skills. Together, policymakers, educators, and employers may consider the findings in this paper as further evidence of the need for focusing on the development and use of soft skills. While some might argue that soft skills would be best developed through informal professional development (i.e., on the job training), scholars in the human resources community have found that soft skills do not transfer well from short-term training situations to on-the-job tasks (Laker & Powell, 2011). Thus, to the extent that policymakers, educators, and employers wish to support soft skill formation, it may be important to think about long-term learning opportunities.

As previously stated, our analyses show that high-numeracy proficiency and the use of all four soft skills are positively, and independently, related to occupational status. However, we also find that in addition to the estimated main effects of numeracy proficiency and use of soft skills, there is a statistically significant interaction effect between numeracy proficiency and the use of planning and influence skills at work. In other words, the relationships between

occupational status and planning (and occupational status and influence) tends to vary among workers with different levels of proficiency in numeracy skills. In practical terms, that means that low-numeracy workers tend to benefit more in occupational status if they more frequently exercise planning and influence skills than workers with high numeracy skills. We did not find evidence of similar relationships among occupational status, numeracy, readiness to learn, and task discretion.

Prior research characterizes soft skills as transferrable (Balcar, 2014), necessary for promotion beyond entry-level jobs (Laker & Powell, 2011), and indicates that they are now needed throughout "the organizational hierarchy" (Brungardt, 2011). Our findings support prior literature by showing that there are positive, statistically significant relationships between soft skills and occupational status. Moreover, our results build on extant research by showing that low-numeracy workers get more "pay-off" from exercising planning and influencing skills than high numeracy workers.

Regression results suggest that American and European policymakers have done well to consider the importance of soft skills both for employers' needs and for the potential benefits that soft skill formation may bring to individual employees (potentially for taking higher status occupations or for using soft skills to work in those occupations). However, U.S. surveys or reports and EU policymakers have discussed a battery of soft skills, categorized as different clusters and characterized by different tasks. Our results show that when we simultaneously analyze multiple measures of the use of soft skills, only some are statistically significantly related to occupational status. Academic or professional units, such as business schools, have shown that they are able to determine the types of soft skills that are most needed by their students to work in their professions (e.g., Beard et al., 2008). However, policymakers may need

to carefully consider whether to continue to promote a broad range of soft skills or to focus on certain types of soft skills as being transferrable throughout the economy. Future research may build on our preliminary findings by distinguishing different soft skill domains and examining independent effects of those domains to further inform policy discussions about national efforts at soft skill formation.

In terms of educational policy, standardized tests and common core curricula tend to focus on English language skills, such as literacy, and mathematical or numeracy skills. However, some scholars argue that schools and educational policies should not become so focused on teaching numeracy and literacy that they neglect the other types of learning and skill formation that students need after graduation (e.g., Labaree, 2014; Osher et al., 2016). The analyses in this paper suggest that educators should consider the ways that their students may use soft skills in addition to skills such as numeracy. Providers of lifelong education opportunities and adult education programs, such as community colleges, may consider the ways that they can help students develop soft skills. In particular, more research should be conducted to determine whether workers with low numeracy proficiency may benefit from educational interventions that focus on soft skill formation.

Limitations

This paper identifies important correlational relationships between numeracy skills, perceptions of the use of soft skills at work, and occupational status after controlling for multiple background characteristics, such as gender, age, and immigrant status. However, the findings and arguments in this paper do not support causal inferences or relationships. Indeed, relationships could go either way. For instance, occupational status may not only be predicted by the use of

soft skills, but occupational status may also help determine whether and how soft skills are used at work. With the data at hand, we cannot distinguish the direction of the relationship.

PIAAC's measures of numeracy skill are quite rigorous, but foundational skills could be measured in different ways. For example, researchers could use the PIAAC literacy assessment scores, which is meant to measure a different type of skill domain. However, the PIAAC numeracy and literacy assessment scores are highly correlated and yield similar statistical results in analyses of labor market outcomes (Hanushek et al., 2015), which suggests that there were not statistical limitations to using numeracy over literacy when working with the PIAAC dataset. Future researchers may consider whether there are foundational skill measures in datasets other than PIAAC that could differently or more completely measure foundational skills (as mentioned earlier in the paper, in a 2001 study Heckman and Rubinstein used data from GED tests and military aptitude tests to study foundational and soft skills).

Unlike the numeracy assessment, the soft skill use variables were scale scores derived from items included on the background questionnaire. In other words, Readiness to Learn, Influence, Planning, and Task Discretion were not core constructs in the PIAAC dataset. As such, the measures of the use of soft skills at work are not true measures of workers' soft skills. Throughout the literature, soft skills are notoriously difficult to define, and the PIAAC index variables of the use at skills at work are not the perfect measures of soft or general skills. Nevertheless, the variables representing the use of soft skills at work are internationally validated and comparable. Despite the limitations of using the secondary soft skill measures from the background questionnaire, the PIAAC data allowed us to test whether some measures of soft skills were independently related to occupational status and whether the soft skill variables moderated the relationship between a more traditional measure of foundational (numeracy) skill

and occupational status. This was an important application of the PIAAC data as an initial step in addressing the ways that numeracy skills may be complemented by so-called “soft” attitudes, abilities, and attributes.

Another significant limitation of the current study is that we did not include measures of educational attainment or credentials in our analyses. Educational attainment (i.e., years of schooling) or educational credentials (i.e., degrees) are often used as proxies for foundational and non-foundational skills or even socialization (e.g., Bowles & Gintis, 2002). In other words, our economic theoretical framework suggests that educational credentials are often used as signals for multiple types of skills (e.g., Becker, 1964). In our analyses we sought to use the unique strengths of the PIAAC dataset to test the relationships between the underlying skills, which are acquired through educational attainment, and occupational attainment. Because educational attainment or credentials is highly correlated with numeracy skill (the Pearson’s correlation coefficient between years of schooling and numeracy scores is 0.62), we did not include both measures to avoid multicollinearity issues. By measuring numeracy skill and soft skills separately, we attempted to tease apart the relationships between different types of skills, rather than use a single proxy (education) as a measure of a worker’s abilities. Future research may examine the relationships between soft skills and educational attainment or credentials.

Given the focus of this study is occupational status or job prestige, we intentionally chose prime-age workers between the ages of 30 and 59 for our analytical sample. They are most likely to have completed all their formal schooling and have had time to establish themselves at work. So the results of the analyses only apply to prime age workers who are currently employed in the United States. Younger and older workers were included in the PIAAC dataset. Therefore the results may not be generalized to all prime-age workers in the U.S. The second wave of the

PIAAC data collection in 2014 included incarcerated populations. Future research may examine similar relationships among teenagers and young adults, seniors, and perhaps even incarcerated populations.

Conclusion

In this report, we set out to offer timely and important analyses for policymakers who are focusing on the role of soft skills, in addition to foundational skills such as numeracy, in the 21st century labor market. We regressed measures of occupational status on PIAAC numeracy assessment scores and soft skill index scores based on self-reported data from PIAAC's background questionnaire. Regression estimates indicate that even after we account for numeracy skill, there are positive, statistically significant relationships between the use of four types of soft skills at work (Readiness to Learn, Influence, Planning, and Task Discretion) and workers' occupational status. Specifically, two standard deviation increase in numeracy scores (about 115 score points) is associated with one standard deviation increase in *Occupational Status* (about 15.9 points). A six standard deviation increase in *Influence* (a standard deviation is about 1.07) is associated with one standard deviation increase in *Occupational Status*. Among other control variables, having a college graduate parent is associated with a quarter standard deviation of occupational status. The effect of having a college graduate parent on *Occupational Status* therefore is equivalent to half a standard deviation increase in numeracy scores and 1.25 standard deviation increases in *Influence* scores.

When all the soft skill measures were entered into the regression model simultaneously, Influence still had independent, statistically, significant, positive relationships with occupational status. Finally, our analyses provide evidence of interaction effects between high numeracy proficiency and two aspects of soft skills, i.e. planning and influencing. This last finding

suggests that workers with lower levels of numeracy proficiency get more “pay-off” from exercising planning and influencing skills than high numeracy workers.

Policymakers and scholars may continue to address the relationships between soft skills, numeracy, and occupational outcomes. This report provides interesting, but only preliminary findings about the ways that soft skills and foundational skills may complement each other in the labor market. Educational programs and professional development trainings may seek to identify opportunities to improve both foundational and soft skills, as well as ways to do so among different groups of workers (e.g., those with low levels of numeracy proficiency).

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Appendix A

Listing of PIAAC Background Questionnaire Items Used to Generate Skill Use Indices

Index Variable	PIAAC Background Questionnaire Items (Variables) Included in Index
Influence	*How often does your job usually involve . . .* - instructing, training or teaching people, individually or in groups? (F_Q02b) - making speeches or giving presentations in front of five or more people? (F_Q02c) - advising people? (F_Q02e) - planning the activities of others? (F_Q03b) - persuading or influencing people? (F_Q04a) - negotiating with people either inside or outside your firm or organisation? (F_Q04b) Response set: 01 - Never 02 - Less than once a month 03 - Less than once a week but at least once a month 04 - At least once a week but not every day 05 - Every day DK - Don't know RF - Refused to answer
Planning	*How often does your job usually involve . . .* - planning your own activities? (F_Q03a) - planning the activities of others? (F_Q03b) - organising your own time? (F_Q03c) Response set: 01 - Never 02 - Less than once a month 03 - Less than once a week but at least once a month 04 - At least once a week but not every day 05 - Every day DK - Don't know RF - Refused to answer
Task Discretion	*To what extent can you choose or change . . .* - the sequence of your tasks? (D_Q11a) - how you do your work? (D_Q11b) - the speed or rate at which you work? (D_Q11c) - your working hours? (D_Q11d)

	Response set: 01 - Not at all 02 - Very little 03 - To some extent 04 - To a high extent 05 - To a very high extent DK - Don’t know RF - Refused to answer
Readiness to Learn	*I would now like to ask you some questions about how you deal with problems and tasks you encounter. To what extent do the following statements apply to you?* - When I hear or read about new ideas, I try to relate them to real life situations to which they might apply (I_Q04b) - I like learning new things (I_Q04d) - When I come across something new, I try to relate it to what I already know (I_Q04h) - I like to get to the bottom of difficult things (I_Q04j) - I like to figure out how different ideas fit together (I_Q04bl) - If I don't understand something, I look for additional information to make it clearer (I_Q04m) Response set: 01 - Not at all 02 - Very little 03 - To some extent 04 - To a high extent 05 - To a very high extent DK - Don’t know RF - Refused to answer

Appendix B

Description of PIAAC numeracy discrete achievement levels

Achievement level and score range	Task descriptions
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.
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 percents such as 50%, and locating and identifying elements of simple or common graphical or spatial representations.
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, percents and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.
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 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 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.

Source: Technical Report of the Survey of Adult Skills (PIAAC) 2013a.