**Career Advancement and Skill Requirements**

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**Abstract:**

The skills that jobs require are a central attribute in the management of employees and in determining employment outcomes. They are the essence of “job requirements” in the hiring process, they feature heavily in compensation design, the construction of job ladders, and so forth. Despite their importance and perhaps because of the difficulty in measuring them objectively, skill requirements have received considerably less attention in research than do the outcomes they drive.

Similarly, the topic of careers and especially career mobility has also been studied much less than its importance merits. One reason for that is the difficulty in measuring career advancement objectively. We use measures of the skills required in jobs to examine advancement in careers for the jobs held by a representative sample of US college graduates in the first decade of their careers. We use the theory of cumulative advantage to examine changes in career advancement. Among other things, we find that the skill requirements for the jobs held by these graduates change little over this period; academic ability and college prestige are especially associated with securing initial jobs that have greater requirements and that this advantage continues to influence subsequent jobs a decade later.

**Introduction:**

As Hughes (1937) defined it, careers are a series of jobs or offices that individuals move across that are defined by employers and that come with different levels of status, a definition that most researchers have adopted. The most fundamental question in the study of careers is arguably identifying the pattern of that movement, especially advancement. Particularly for those interested in organizations and in society, advancement matters because it determines who gets access to the most important and most interesting jobs, and who gets the largest rewards, shaping patterns of inequality and intergenerational mobility.

The fundamental research on contemporary careers identified emerging patterns empirically and then described them with concepts such as “orderly” careers (Wilensky 1961) or “executive careers” associated with corporate employment practices for white collar jobs (Kanter 1997).

A great challenge in studying patterns in careers has been to establish criterion to determine advancement. While it is straight-forward to assess whether an individual changes employers or even changes job title, whether those moves constitute a step up and how much of a step can be difficult to say.

Virtually all of the research on careers has assumed a criterion to measure movement based on formal authority, which is a concept typically defined within individual organizations. That choice was no doubt shaped by the fact that employment tended to be long-term within the same organization, and the people who got to the top of those organizations got there internally (e.g., DiPrete 1987 in sociology, Markham, Harlan, and Hackett 1987 in psychology).

Organizational charts describe the hierarchy of authority across jobs. Given a common organizational chart and consistent job titles, it is clear which jobs have greater formal authority – typically greater status as well - and therefore which moves represent advancement.

Because employers have different organizational charts and may use job titles differently, it can be challenging to determine what constitutes career advancement when moving across organizations. Now that job changes across organizations are common, especially for white collar workers where the focus of career research has been (e.g., Cappelli, Hamori, and Bonet 2014), assessing and especially measuring career outcomes becomes more difficult. There are notable exceptions, of course, including studies of lawyers, where advancement from associate to partner is a standard progression at least in most law firms (e.g., Gorman and Kmec 2009).

The most common criterion for examining the effects of changing jobs has been wage outcomes. Inside large corporations where pay levels were established through job evaluation, higher pay rates arguably did correspond to increased responsibilities and authority. Whether that remains the case when we consider job changes across organizations is an open question.

While there is little doubt that higher wages are seen as an improvement for employees, other things equal, there are many reasons why wages are difficult to interpret as an objective outcome of advancement as usually understood in the topic of careers. Those concerns begin with the fact that the most important factor shaping market wages is simple supply and demand, which is beyond the control of any individual employee or any employer to influence. Consider a petroleum engineer whose compensation over time has varied greatly based on the demand for oil. It would seem strange to suggest that the rise in wages that take place for a petroleum engineer during oil booms constitutes career advancement or that the collapse of wages after would be a good measure of career decline. Other factors influencing wages that are unrelated to the nature of the job might be rent sharing, which might vary across employers as well as over time within the same employer, and incentive pay programs, where pay varies with individual and organizational performance.

Another measure used to assess jobs or roles consistently across organizations is occupational prestige, which reflects how individuals in society or in some cases experts perceive the social status of those in different occupations. The limitation of this measure is that a great deal of what we typically see as advancement in careers takes place through job changes within the same occupation – e.g., the move from “test engineer” to “engineer” to “senior engineer” – which would not be captured as a change in prestige. There is also evidence that occupational changes are actually less frequent now than other types of job changes, which further limits the usefulness of prestige as a measure of careers. [cite] PENN

In the arguments below, we identify a different measure for assessing career advancement that is applicable for moves across organizations as well as within them, and that is the requirements of jobs. While this measure has been used extensively in psychology in part to create job structures for advancement inside organizations, as noted in more detail below, it has not been used extensively in studies of career advancement. Job requirements have many advantages over previous measures: they are consistent with the underpinnings of formal hierarchies within individual organizations (job evaluations that create those hierarchies rely on skill requirements), they measure attributes like education that are the focus of policy discussions as well as demand-side attributes, and they can be subdivided into very specific components that have obvious practical implications.

We apply measures of job requirements using the well-known “knowledge, skills, and abilities” framework to a nationally representative sample of college graduates where we can follow their movement across jobs over time. We then use the government’s O\*Net database to translate job titles into requirements.

These three components relate to important debates in contemporary society as well as in the world of research. REFERENCES HERE - The different components relate to different institutional arrangements: “Knowledge” is closely identified with academic learning as provided by schools while “Skills” relates more closely to expertise learned on-the- job. The current debate about how valuable STEM (Science, technology, engineering, and math) education can be investigated by examining the role of “knowledge” in jobs. “Abilities” reflect attributes that are more dispositional. Changes in the requirements of jobs as individuals advance across careers therefore have important implications for these different institutions. Following the practice in the policy literature, we refer to job requirements collectively as “skill requirements”

Among the most interesting descriptive findings below are that the job requirements that individuals hold do not increase greatly from their first job after college graduation to a period ten years later; STEM skills are not strongly associated with career progression; KSA’s associated with liberal arts actually show a greater increase; the importance of abilities actually declines; and women hold jobs that have lower skill requirements .

We also attempt to explain the pattern of advancement across individuals over time using the framework of cumulative advantage. We examine four different attributes that are thought to drive cumulative advantage, especially in career outcomes. The first is cognitive ability, especially as associated with academic endeavors. The second is socio-economic background of one’s family. The third more directly captures social status, and that is the social prestige of the college one attended. The final attribute is academic achievement, as a measure of knowledge learned but also of effort and prior achievement in a different realm.

In the process, we also assess the three different ways highlighted in prior research in which advantage may operate: initial advantage, as measured by the requirements of one’s first job, continuing advantage, as measured by the increase in requirements of subsequent jobs, and increasing advantage, as measured by changes in the relationships between these advantages and subsequent job requirements over time.

We find strong evidence of that these four attributes create initial and continuing advantage in securing jobs with greater knowledge and skill requirements but persistent evidence of negative relationships with ability requirements. There is considerably less evidence that the importance of the advantages increases over time. We also find continuing advantage with respect to jobs per se in that securing an initial job with higher KSA’s leads not only to jobs with higher KSA’s later in one’s career but that the increase in KSA’s is higher, other things equal.

 **Theories of Career Advancement**:

The earliest US arguments about career advancement developed around the perception that intergenerational mobility had changed. Descriptions of the social background of business leaders – virtually all owners - were compared to those from earlier generations (e.g., Joslyn and Taussig 1932) initially showing the importance of inheriting one’s position. By the 1950s, study of career advancement shifted to professional executives with more attention paid to the experiences over their own lifetime (e.g., Newcomer 1955). Subsequent studies focused on social systems that shaped the advancement of contemporary executives (Whyte 1956; Kanter 1977), although examples that contrast experiences between age cohorts continue (e.g., Cappelli, Hamori, and Bonet 2014).

Rigorous explanations of advancement in contemporary organizations came later and focused initially on the attributes of those organizations, such as promotion systems (Rosenbaum 1984) and internal labor markets more generally (Baron, J. N., Davis-Blake, A. and Bielby, W. T. (1986); vacancy chains and differences in the demographic balances across organizations (e.g., Stewman and Konda 1983); more recently social capital and social networks (e.g., Podolny and Baron 1997; Seibert, Kraimer, and Liden 2001). Studies of advancement into CEO roles occupied a separate niche where the attributes of individuals were more important (e.g., Thorton and Ocasio 1999).

These studies of advancement within organizations added considerably to our understanding of the factors that shaped advancement inside organizations. In terms of explaining career advancement across the economy as a whole, though, they are less useful, other than the implicit argument that some individuals happen to be in organizations more favorable for advancement than others (Briggs, Jaramillo, and Weeks 2012 investigate why individuals may be sorted or selected into organizations with different internal labor markets).

Studies that consider career advancement more broadly must now include movement across organizations as well, which shifts the analysis to include the labor market. Because it is difficult to consider the effects of employers on each employee in the labor market, questions about career advancement in the broader society as a practical matter shift explanations from the organizational level of analysis back to the individual level. These explanations about individual experiences have been most common, not surprisingly, in economics where the unit of analysis has long been at the individual level.

The goal in these studies has been to explain the wage growth of individuals rather than advancement based on job titles. Human capital is the dominant explanation in this context, the notion that employees earn more when they acquire more of it. Skills are acquired through a conscious decision either by the individual or the employer to pay for them in anticipation of a return in the form of higher productivity and/or higher wages for the individual (see Becker 1964 and Willis 1987 for classic overviews). Why some individuals secure those skills and others do not is explained mainly by differences in ability and access to capital. Training of various kinds, including on-the-job experiences, also counts as human capital. Skills acquired at work, either through formal training or on-the-job learning, are the common explanation as to why wages tend to rise with tenure.

Related explanations of advancement use the notion of learning in a different way, in the form of job search, where individuals search and eventually find jobs whose requirements are better matches for their human capital (see Manroop and Richardson 2016 for a cross-discipline review). The search explanation should only explain a modest amount of career advancement, though, as it typically focuses at one point in time when the human capital of the searchers is constant. Especially in economics, the matching idea assumes that incumbents in jobs have the skills necessary to meet job requirements. More controversial, as noted below, is the reverse attribution, that job requirements can be proxied by the skills of the individuals in them, especially where “skill” is proxied by education.

Investigations that consider organization-level factors that examine career advancement in the broader labor market focus on changes in general practices, such as corporate restructuring (e.g., Fligstein 1991) or patterns of business creation and destruction e.g., Haverman and Cohen 1994) as opposed to attempting to explain patterns of career advancement per se. As Bidwell and Briscoe (2010) note, little has been done to examine skill development and career movements from this perspective when individuals move across organizations. More generally, interest in career advancement appears to have declined. A search of the Sociological Abstracts database of publications under the subject heading of “career advancement” finds only 50 publications since 1976, and 70 percent of those focus on quantifying gender differences in overall advancement as opposed to explaining patterns of advancement.

There is an extensive body of research in organizational psychology on attributes of individuals that affect their movement across jobs, especially since Shein (1978). Some of it measures career advancement based on the satisfaction of individuals with their position; more use objective measures, including wages, relying on psychological states and values as the drivers, such as motivation to advance or personality types (see Ng, Eby, Sorensen, and Feldman 2005 and Thanou 1997 for a review). How much of the variation in career advancement across the economy can be explained with these measures is difficult to say because the measures behind them, such as personality assessments, are difficult to find in large, representative datasets of the population.

**Theory of Cumulative Advantage:** Arguably the most useful explanation and certainly the broadest as to why some individuals advance in the labor market and in society, not just in organizations, is the theory of cumulative advantage. It is also known as “the Matthew Effect,” from the biblical parable that more is given to those who already have. Operationally, the notion is that initial advantages give one access to greater advantages at later stages, which in turn drives achievement and advancement (Merton 1973; 1988).

The first studies of cumulative advantage by Merton were in the professoriate where those who already had strong reputations were given disproportionate credit for contributions made with less famous colleagues. Arguably the best-known examples of cumulative advantage are in education, beginning with learning, where students who came to school ahead of their peers in terms of academic knowledge and abilities (e.g., those who already know how to read or who have higher IQ’s) were found to be sorted into situations that provided them with greater opportunities to learn more and do so faster (Stanovich 1986). Among the most sophisticated of the attempts to apply the notion of cumulative advantage to career advancement is Allison et al. (1982), which applied the concept to the career advancement of scientists.

Implicit in hypotheses of cumulative advantage is the notion that access to resources is not equal across individuals and that there is something of a competition for career advancement across individuals in the workplace (See Zuckerman 1988 and DiPrete and Eirich 2006 for reviews).

As DiPrete and Eirich (2006) note, there are different interpretations as to how cumulative advantage is defined. The “strict” view requires that the advantage associated with an initial resource actually increase over time, a mechanism that would help explain growing social inequality; the weaker view, attributed to Blau and Duncan (1967), is less restrictive and is consistent with situations where initial resources have both direct effects (e.g., students with more ability learn to read faster) and indirect effects (e.g., students with more ability are given more resources that help them learn faster).

Part of the appeal of the cumulative advantage notion is its generalizability across a wide range of contexts. A caveat to its usefulness is in that it does not always identify the mechanism through which the advantage operates in part because many mechanisms are typically involved. For example, the hypothesis that students of more famous faculty have greater career success contains many potential causal arrows: are the students more able initially, do they learn more from more famous faculty, is access to resources better, and so forth). Sorting them all out and allocating importance to each is extremely difficult. More generally, the idea that those who have succeeded already are more likely to succeed in other endeavors is consistent with a range of other explanations, such as confirmation bias along the lines of a halo effect (Thorndike 1920) or a matching story associated with synergies (i.e., those who demonstrate ability are more likely matched with resources that make use of that ability). Because cumulative advantage arguments typically do not sort out all these possible channels, it may be more accurate to think of them as statements about association, something that simplifies estimation considerably. It is also possible that the mechanisms of advancement associated with a given resource may shift over the course of one’s career. Initial ability, for example, might lead to initial achievement, which is reinforced in ways that increase motivation, which leads to further success and matches with higher-status institutions, the affiliation with which leads to advancement in the next stage, and so forth.

A central attribute of cumulative advantage is that the resource of interest in the first period is different than the advantage it secures in the second. In other words, it is not about a simple head start, e.g., that children who have above average reading proficiency entering grade one will have above average proficiency at the end of grade one. It is that the initial advantage leads to a different treatment in the next period that, in turn, pushes achievement beyond what one would anticipate based solely on the initial advantage.

The null hypothesis for cumulative advantage across periods is arguably regression to the mean: Individuals whose performance is above average in one period, other things equal, are likely to perform below average in the next period. In that case, we might expect to see initial advantages dissipate and reverse over time.

In the arguments that follow, we adapt the Blau and Duncan (1967) version of cumulative advantage to examine the role that the initial resources individuals have before entering the labor force play in advancing their careers but we also examine the strict form of increasing effects..

As Merton (1987) also noted, it is fundamental to establish what the phenomenon we are studying really is before jumping ahead to try to explain it. In the context of careers, that phenomenon is the movement of individuals across jobs. Even when we focus on regular, full-time jobs, we have very little information about what careers look like now, especially when we include the effects of movement across employers (exceptions include Bidwell and Mollick 2015; Bidwell et al 2015). To the extent that there have been efforts to identify the patterns that define careers, they have been mainly negative, suggesting that the old patterns no longer apply (Osterman 1996; Cappelli 1996) or normative arguments about what is implied by the old order changing (e.g., Arthur and Rousseau 1996). We turn next to the question of identifying and measuring the job changes that constitute career advancement.

**Measuring Career Outcomes**

Career advancement requires a criteria to measure it. We use a criterion that has been used extensively for related questions, albeit not in this context, and that is the skill requirements of jobs. We measure the movement of individuals across jobs, the phenomenon that defines a career, in terms of changes in the requirements of the jobs individuals hold.

Skill requirements are important in their own right, of course. Potential changes in them are one of the central features behind current debates as to whether there are “skill gaps” not only in the US but elsewhere (Cappelli 2015); they increasingly are used to shape curricula in post-secondary institutions; they feature prominently in debates about pay fairness, including required reporting by employers on pay differences by jobs with equal skill requirements (White House 2016).

Job requirements have traditionally been defined around the idea of skill. The word “skill” comes from the Old English word for discernment (Oxford 2016), but contemporary definitions focus on having the attributes that allow one to perform a task.

Many of the best-known studies related to skills have typically relied on indirect proxies to measure skill, especially in economics where the education level of incumbent employees is used to measure job requirements. Perhaps the best example of this is the notion of skill-biased technological change (Tinbergen 1974), which suggests that new technologies require more skilled workers and that, over time, the continual introduction of new technology leads to ever higher demand for more skills. Katz and Murphy (1992) produced evidence consistent with the Tinbergen view by looking at the college wage premium (measured relative to the wages of high school graduates) over time. Many of the arguments about rising wage inequality in the US are based on the assumption of skill-biased technological change increasing the returns to education per se (e.g., Goldin and Katz 2008).

Securing direct measures of actual work-related skills possessed by individuals is difficult in part because skills are often job and context-specific, so the measures would need to be as well. Researchers trying to measure skills across contexts typically fall back on using academic skills, such as with the recent PIAAC skills study conducted by the OECD, which relies heavily on measures of reading and math proficiency (OECD 2016). The availability of data on education levels has certainly made that measure popular, but most observers of the workplace would suggest that the education levels of individuals are at best a limited proxy for the skills actually needed to perform jobs. Liu and Grusky (2013) offer a trenchant critique of the problems associated with using the education of incumbents to measure job requirements.

By far the most systematic discussion of job requirements comes from the field of industrial/organizational (I/O) psychology where long-standing efforts to identify both the types of skill and the extent of skill have been at the foundation of employee management practices, such as selection and training programs (e.g., identifying skills that need to be hired and developed), and compensation systems (e.g., making certain that pay differences are in line with skill differences). Scientific management and an industrial engineering approach to the design of jobs is also based on having rigorous definitions and measures of job requirements.

The practice of human resources could arguably be said to begin with job analysis (Wilson 2007), which is the process of identifying the tasks that are performed in a proposed job and from that building out statements of job requirements that individuals who would hold those jobs would be expected to perform. It has a long history that dates to the early 1900s (see Zerga 1943) and to the beginnings of both contemporary industrial engineering and industrial/organizational psychology. The techniques used to identify those requirements include direct observation by experts for existing jobs as well as interviews with incumbents in those jobs. Systems for conducting that analysis include the Position Analysis Questionnaire, which outlines a classification system for making judgments about job requirements (Brannick, Levine, Morgeson 2007).

Job requirements define and then create jobs. From there, they are used to drive the hiring process: on the employee side of the search process, job requirements are what potential candidates see. They also are at the heart of traditional compensation decisions, especially the practice of “job evaluation,” which attempts to address fairness and related issues in the relative pay of jobs in the same organization (see Gupta and Jenkins 1991). Job requirements also drive training and development practices where the goal is to raise employee abilities to match the requirements of jobs. They also inform performance management by establishing the tasks employees must perform in their jobs.

There are a variety of ways in which job analyses can be conducted (see Brannick and Levine 2002 for examples), but the taxonomy that underpins most of them differentiates “knowledge” (a body of information relevant to a job, the attribute most associated with traditional education), from “skills” (psycho-motor behaviors associated with performing specific job tasks), and from “abilities” (dispositions like intelligence) or KSA’s. While there are issues as to how the distinctions among these three attributes are in practice operationalized, there is little doubt that they reflect separate and important concepts. Many job seekers encounter the KSA framework because applications for jobs in the Federal Government continue to require job seekers to outline their attributes using the KSA framework.[[1]](#footnote-1)

The U.S. Department of Labor’s Dictionary of Occupational Titles (DOT) established job requirements in the economy using the KSA framework by having trained experts conduct job analyses on benchmark job titles. Its successor beginning in 1998 and the most wide-ranging use of the KSA framework now is with the US Department of Labor’s online Occupational Information Network or O\*NET database (see Tippins and Hilton 2010 for an overview).

The information in O\*NET about the requirements of jobs began with a random sample of businesses expected to employ workers in benchmarked occupations. Then a random sample of workers in those occupations was selected from within those businesses to have their jobs analyzed by experts. The information they obtained about the job requirements of those occupations formed the basis of the O\*NET. That information has been updated continually for each occupation by collecting new data from surveyed workers asking about their jobs using standard job analysis questionnaires. O\*NET uses its own taxonomy of 974 occupations that is derived from the Standard Occupational Classification. The O\*NET Content Model is based on the KSA taxonomy, which it expands to six domains and 277 standard descriptors. In addition to identifying the type and level of knowledge, skill, and ability required for jobs, the O\*NET also establishes the importance of the KSA requirements to each job.

Using the O\*NET to establish the skill requirements associated with a particular job title is straightforward: Identify the job in question, match it to the O\*NET, and then identify the KSA’s required for that job. (Handel 2016 reviews the attributes of the O\*NET data in detail.)

The outline above suggests some of the reasons why using job requirements as a measure of career advancement is appropriate. First, job requirements are used to build the hierarchies inside organizations that reflect authority and responsibility. Second, job requirements are used to establish human resource structures, and the extent to which they represent knowledge and skills that are produced by investments, they reflect human capital arguments. Third, we know from research in psychology that jobs with greater skill requirements contribute to positive psychological outcomes, such as autonomy (Loher et al 1985; Arnold 1995). Finally, K,S,A levels are associated with more desirable jobs – higher wages and greater prestige (Handel 2016).

**Research Using KSA’s and O\*NET:** The research associated with the KSA framework and the O\*NET in particular is extensive. Among the studies related to the O\*NET taxonomy are Converse et al. (2004), which found, not surprisingly, that it was better at matching people to occupations than to jobs that are more specific to organizations; Walmsley, Natali, and Campbell (2012) examined the validity of incumbent data on the requirements of jobs in the O\*Net data to that from analysts; [Converse](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Converse%2C%2BPatrick%2BD./%24N?accountid=14707) and [Oswald](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Oswald%2C%2BFrederick%2BL./%24N?accountid=14707) (2004) looked more broadly at how the choice of ability measures affects how jobs are grouped into clusters. Atkins (2012) describes how employers can use such data to structure careers for employees, and Hedge, Borman, and Bourne (2006) show how the US Navy uses a similar framework to create job structures and paths of advancement through them.

While the skills individuals possess are undoubtedly broader than the requirements of the jobs they hold, there are nevertheless good reasons for thinking that the job requirements we assess represent at least the minimum level of skill an incumbent in those jobs possesses, the key assumption behind both fit arguments in psychology and sociology and matching arguments in labor economics. The reason for that is because of the costs to an employer if that was not the case: an employee who is underqualified, other things equal, performs the job poorly and in doing so can create knock-on problems for the employer as the underperformance spills over to other aspects of business.

The most studied question related to skill in the labor market has been whether average skill requirements in the labor market as a whole have been rising or falling. This literature is relevant here in part because the measures of skill and the techniques used to examine them are similar.

The literature on this topic and on topics directly associated with it goes back generations, and only a subset of it can be presented here. Contemporary studies first compared editions of the Dictionary of Occupational Titles, the precursor to the O\*NET, to see how the requirements of those jobs were changing (e.g., Spenner 1983). More generally, the debates on what has been happening to skill requirements range from visions on the one hand that employers are relentlessly driving skill requirements down (e.g., Braverman 1974; Attewell 1987) to the equally dramatic contention of the skill-biased technological change idea that such requirements are inexorably rising. Autor, Levy, and Murnane (2003) assert that information technology systems are increasing non-routine, higher-skill tasks while reducing lower-skill, non-routine tasks. A recent survey of the literature as to whether there is a necessary direction to trends in overall skill requirements also by the National Academy of Sciences suggests the answer is probably no. While there appear to have been modest increases in skill requirements overall, the choices as to how technology are introduced and jobs are designed appears to be the main factor determining whether job requirements change (Hilton 2005).

Liu and Grusky (2013), in a study with a method very similar to ours, use a sample of jobs from the Current Population Survey (CPS) in the 1970s and again to a contemporary sample to examine changes in job requirements associated with the hypothesized “third revolution” put forward by some advocates of the skill-biased technological change idea. They find statistically significant but modest increases in some skill requirements over the past decades.

A smaller set of studies use skill requirements as independent variables, typically to explain wage outcomes. O’Shaugnessy, Levine, and Cappelli (2001) use a proprietary measure of skill requirements and find that changes in the returns to the measure of skill there explain the growing wage inequality within firms; Sackett and Rotundo (2004) also use a different, proprietary skill measure to look at skill wage premiums and find that the general factor (“G”) in intelligence is associated with most of the return to skill. Spitz-Oener (2006) examines changing skill requirements within Germany with a data set measuring skill and education requirements. Hirsch (2005) concludes that differences in skill explain much of the wage differences between full and part-time work. Van Zanden (2009) uses a measure of the wage premium associated with skill to explain the historical pattern of GDP growth between west and eastern countries over the past 500 years. Levenson and Zoghi (2010) use the Federal Government’s skill taxonomy for its own employees, compares it to occupational classifications, and finds the latter introduces bias as a measure used to explain wages.

An important conclusion from the literature is that while there is a very detailed and primarily normative literature on how skill requirements should shape the structure of jobs and related outcomes on the one hand and a much more abstract and more conceptual literature at the economy level associated with describing changes in average skill levels on the other, there is very little in between. That includes questions about what happens to skill requirements for individuals over the course of their career.

An additional factor affecting job requirements beside skill level is the level of importance or responsibility associated with those skills. The abilities required for machinist work (e.g., precise hand-eye coordination), for example, may be similar to those required for neurosurgery, but the consequences of the latter are much greater and contribute to the fact that we see surgeon as a more important job than machinist. The importance of job tasks is a component of the job analysis process, and the O\*Net system generates estimates of importance for the KSA’s associated with each job.

**Data and Hypotheses:**

We use data on the jobs that individuals hold from the Baccalaureate & Beyond Longitudinal Study (B&B) conducted by the US Department of Education’s National Center for Education Statistics to examine career advancement. The study collected information from a sample of students who received a bachelor’s degree during the 1992–1993 academic year and follows them for 10 years. The sampling frame was drawn from a survey of post-secondary institutions, the National Postsecondary Student Aid Survey, and was weighted to reflect the population of all such graduates in that year to create a sample that was representative of all four-year college graduates.

Extensive information was collected from the students initially about their backgrounds, their families, and their academic and related experiences before they graduated. Among other things, the data provide good measures of attributes that exist before college, such as intellectual ability and family background, that can be used to examine cumulative advantage arguments.

The study contacted them again in 1994, 1997, and 2003, this time collecting information about their work experiences and their life. The data allow for detailed identification of jobs performed, as opposed to broad occupational classes. The 1992-1993 data had 11810 respondents; the 2003 resurvey contained 10440. We discuss survivor bias below. The response rate for each wave of the survey was roughly 90 percent. NCES replenished some of the sample in each wave with subjects identified in the original data collection exercise, but the number of individuals who completed all three waves was still less than the number in 2003.[[2]](#footnote-2)

We match the information about the jobs respondents held to the O\*NET to generate the skill requirements of jobs as proxied by their respective KSA’s. We then examine changes in the KSA’s of the jobs held by the respondents from 1994 to 2003. The matches were made by hand-coding the respondent’s reported job title to the appropriate O\*NET entry. 1350 distinct titles were contained in the text box, and these were mapped onto 550 O\*NET categories. Two raters established the criteria for assignment and had 97% agreement on the subsequent matches. The data here are representative of the experience of college graduates over this period, and the jobs they held should be representative of the population of college grad jobs over the same period.

Among the general questions we might be able to address with descriptive results is simply whether the general view of careers is true, that individuals on average advance into jobs that require more skills, broadly defined, and that have more responsibility. We can also see how the requirements for knowledge, which proxy classroom-based learning, change for individuals over the course of their career and whether increased job requirements might drive a need for continuing education or “lifelong learning.” Given the attention devoted to STEM skills (which map onto the “knowledge” dimension) in the world of policy, does the need to for those skills rise over time? We can address a similar question about workplace skills, which reflect experience-based learning. It is less clear what to expect about how the demand for abilities changes over time.

Table 1 shows mean scores for the level and importance of K, S, and A for the jobs held by the sample of respondents in 1994, 1997, and 2003. The results show that overall, requirements increased over time for the respondents in the study, both the amount of the respective attributes and their importance to the job. T-tests indicate that the increases from 1994 to 2003 are statistically significant, but the magnitude of the increases is often quite small: the level of abilities in the average jobs held by incumbents increases only one percent after nine years, and the increase in the importance of abilities is even smaller. The largest increase appears to be for knowledge – the attribute most associated with education – at eight percent. The increase in the levels of KSA’s is typically greater than the increase in their importance.

To illustrate the practical difference in mean scores, the skill “speaking,” one of several under the broader “Knowledge” heading gets a score of 70 points for lawyers versus 50 for paralegals, the difference is driven by the fact that a lawyer’s job has public speaking requirements arguing cases that paralegal jobs do not have (see https://www.onetonline.org/help/online/scales). Given that the first nine years at the beginning of one’s career are typically thought to be a time when individuals learn a great deal, the magnitude of the increases seems modest.

**Table 1: Descriptive Statistics**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1994 | 1997 | 2003 |
|  | Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Level of Abilities | 104.69 | 20.02 | 8359 | 105.52 | 19.58 | 9505 | 106.08 | 18.19 | 8585 |
| Importance of Abilities | 122.23 | 11.96 | 8359 | 122.42 | 11.69 | 9505 | 123.20 | 11.07 | 8585 |
| Level of Knowledge | 68.08 | 17.52 | 8359 | 72.27 | 17.19 | 9505 | 73.58 | 14.63 | 8585 |
| Importance of Knowledge | 73.98 | 9.17 | 8359 | 75.92 | 9.06 | 9505 | 76.81 | 8.18 | 8585 |
| Level of Skills | 84.66 | 16.94 | 8359 | 88.75 | 15.85 | 9505 | 91.18 | 14.56 | 8585 |
| Importance of Skills | 91.35 | 9.27 | 8359 | 93.48 | 8.47 | 9505 | 95.51 | 7.87 | 8585 |

t-test

|  |  |  |  |
| --- | --- | --- | --- |
|  | Difference | T | p value |
| AbilityLevel 2003-1994 | 1.39 | 4.74 | .000 |
| AbilityImportance 2003-1994 | .98 | 5.52 | .000 |
| KnowledgeLevel 2003-1994 | 5.50 | 22.19 | .000 |
| KnowledgeImportance 2003-1994 | 2.83 | 21.23 | .000 |
| SkillLevel 2003-1994 | 6.52 | 26.91 | .000 |
| SkillImportance 2003-1994 | 4.16 | 31.54 | .000 |

In the Appendix, we examine these overall changes in more detail, looking at the subcategories within “knowledge,” “skill”, and “ability.” Not surprisingly, the changes within some subcomponents of each category are more dramatic than the changes in the overall measure. For example, both the level and the importance of communication knowledge decrease between year three (1997) and year nine (2003) of the careers of these respondents. Both the level and the importance of psychomotor abilities also decrease as does the level and the importance of physical abilities. The only “ability” that becomes more important over time is cognitive ability. Given that our sampling frame is college grads, the vast majority of whom pursue white collar jobs, psychomotor and physical abilities should not be important for advancement. For that reason, we examine only cognitive ability in the results that follow. (Analyses including the full set of abilities are available on request.)

The skill showing the greatest increase both in level and importance is “basic” skills (e.g., learning, listening, and so forth) that facilitates learning. Among the subcategories of “knowledge,” the subcomponent “engineering and technical” that is most associated with STEM (science, technology engineering, and math) shows virtually no increase over the period, although the separate category of “science” shows a larger increase. “Business” and “social science” have the largest rise; “communications” the lowest.

Table 1a shows correlations for the combined K.S.A. score and some relevant outcomes. It is perhaps not surprising that level and importance are highly correlated and that the combined K.S.A. scores over the three periods are strongly related.

As a robustness check on the importance of the K.S.A. scores, we relate them to the income reported by the respondents in the year 2003 and to measures of occupational prestige for the job they hold. In particular, K.S.A. scores in 2003 are related to the respondent’s salary and to occupational prestige in 2003, more so for prestige than salary. To put these correlations in some perspective, salary and occupational prestige, measures that we typically think of as closely related, are only correlated at 0.08 level. The KSA’s scores for individual jobs are important in their own right, but these results contribute to the relevance of the scores. We also relate changes in K.S.A.’s over the 1994-2003 period to changes in income and occupational prestige over the same period and find similar relationships, although these are more modest.

Table 1a: Correlations

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. KSALV94 | 1.00 |  |  |  |  |  |  |  |  |  |  |  |
| 2. KSAIM94 | .95 | 1.00 |  |  |  |  |  |  |  |  |  |  |
| 3. KSALV97 | .49 | .47 | 1.00 |  |  |  |  |  |  |  |  |  |
| 4. KSAIM97 | .47 | .49 | .95 | 1.00 |  |  |  |  |  |  |  |  |
| 5. KSALV03 | .40 | .36 | .47 | .43 | 1.00 |  |  |  |  |  |  |  |
| 6. KSAIM03 | .36 | .38 | .44 | .48 | .90 | 1.00 |  |  |  |  |  |  |
| 7. diffKSALV | -.65 | -.63 | -.09 | -.10 | .44 | .40 | 1.00 |  |  |  |  |  |
| 8. diffKSAIM | -.60 | -.63 | -.08 | -.06 | .42 | .48 | .93 | 1.00 |  |  |  |  |
| 9. occprstg03 | .14 | .16 | .17 | .19 | .29 | .34 | .10 | .13 | 1.00 |  |  |  |
| 10. lnsal03 | .12 | .05 | .13 | .05 | .23 | .09 | .07 | .03 | .08 | 1.00 |  |  |
| 11. Diffoccprstg03 | -.033 | -.03 | -.13 | -.10 | .12 | .12 | .13 | .12 | .47 | .01 | 1.00 |  |
| 12. Difflnsal03 | -.05 | -.06 | -.08 | -.08 | .06 | .03 | .10 | .08 | .08 | .55 | .07 | 1.00 |
| N (Listwise) | 4945 |  |  |  |  |  |  |  |  |  |  |  |

Correlations >.033 are significant at .05 level; correlations >.05 are significant at .001 level. “LV”=level; “IM”=importance; “diff” = difference in scores between 1994 and 2003; lnsal=log of annual salary; occprstg = occupational prestige

Next we turn to our analyses using the theory of cumulative advantage. As noted above, the theory is somewhat agnostic as to the actual mechanisms through which initial advantage transmits future advantage. Cumulative advantage arguments have been a mix of relationships between resources and subsequent advantages that could be seen as functional, such as ability shaping initial academic success, and not functional, such as social status shaping labor market outcomes. Functional arguments may also be consistent with other explanations of advancement, such as human capital theories, tournament-based promotion systems (where succeeding at first is necessary to be eligible to participate at higher levels), innate ability, and so forth.

While appreciating the goal of moving from general explanations of cumulative advantage down to the specific mechanisms through which it occurs, we do not suggest that it is possible to sort out those mechanisms here. We look at what have been some of the most common resources thought to drive advantage: cognitive ability captured before entering the labor market, academic achievement, and two types of social advantage – family income and social status of the respondent’s college. We do so using a consistent estimation format. What we cannot address in an adequate way is concerns about omitted variables that are central to identifying the different mechanisms along the path of advancement.

We begin with simple OLS regressions estimating the KSA scores for the jobs our respondents held at different points in their career. Our understanding is that the KSA scales used are designed to be linear and consistent across the categories of K,S,& A as well as over time (i.e., one additional point has the same meaning at each point on the scale and is roughly equivalent across K,S, an A scales). That makes the coefficients easier to compare. The descriptive analyses above suggest the unimportance of ability attributes associated with physical abilities, which seems understandable for the white collar jobs pursued by college graduates. For that reason, we restrict the analyses below to the cognitive dimension of abilities, something often thought to be important to career advancement. Results including the full set of ability dimensions are available on request.

Given the general nature of cumulative advantage arguments, precisely what should be included in a base-rate model is not straight-forward. We control for factors that are thought to matter in a range of labor market contexts: race and gender, a simple control for industry (manufacturing vs. other), and age at graduation to address the fact that some individuals are already working when they complete college so that the stage of career they are in when surveyed is different. A unique measure we include is the self-reported assessment as to whether the respondent’s job was associated with their major. The notion here is to capture jobs that have stronger academic job requirements, such as nursing or engineering.

We examine the three different ways in which cumulative advantage might be manifest, borrowing from the prior literature. The first is initial advantage, to what extent do resources one has before college contribute to securing jobs with greater requirements. The second is whether those resources continue to contribute to holding jobs with greater requirements in later periods. We can examine jobs in 1997, but we report only results for 2003 first because many respondents have not changed jobs in the three years from 1994 to 1997, which limits the ability to explore differences and second because the hypotheses are the same for 1997 and 2003. Results for 1997 are available on request. Finally, we examine whether these resources lead to increasing advantage with job requirements over time, the strict definition of cumulative advantage.

We explore these different aspects of cumulative advantage with four different types of initial resources. The first is cognitive ability, something that is at least in part dispositional and, most observers would argue, functional in the labor market. We measure that with respondent’s SAT scores taken before entering college. The second is academic achievement as measured by the respondent’s grade point averages. Academic achievement is thought to be driven by ability and effort. We control for ability in the form of SAT scores in order to learn about the relationship between effort and job responsibilities. The third factor we consider is the socio-economic status of one’s family as measured by their reported family income. This measure is outside the control of the respondent although there are multiple ways in which it may influence the nature of the jobs one holds. A related measure is the prestige of the college the respondent attended based on the US News ranking from 1983. The respective hypotheses are outlined in the chart below (Figure 1) and developed in the next section:

Figure 1: Hypotheses Explaining Jobs with Greater Skill Requirements

|  |  |  |  |
| --- | --- | --- | --- |
|  | Initial Advantage | Continuing Advantage | Increasing Advantage |
| Ability | H:1a | H:2a | H:3a |
| Socio-Economic Status | H:1b | H:2b | H:3b |
| Social Status | H:1c | H:2c | H:3c |
| Achievement | H:1d | H:2d | H:3d |

Results begin with our baseline model, which includes control variables and KSA measures as outcomes estimated for each of the three years. This is a repeated cross-sectional analysis.

Table 2: OLS Results Relating Control Variables to KSA’s by Year

|  |  |  |  |
| --- | --- | --- | --- |
| IVs | DV: 1994 Knowledge Level | DV: 1997 Knowledge Level | DV: 2003 Knowledge Level |
| Constant | 54.04\*\*\*(1.09) | 65.59\*\*\*(1.13) | 68.79\*\*\*(1.07) |
| White |  2.03\*\*\* (.52) |  1.83\*\* (.54) |  2.07\*\*\* (.51) |
| Female |  -2.24\*\*\* (.38) |  -1.57\*\*\* (.39) |  -2.41\*\*\* (.37) |
| Age when getting a BA degree |  .07\* (.03) |  .04 (.03) |  .03 (.03) |
| Job related to major (1994 job)  |  6.52\*\*\* (.23) |  3.52\*\*\* (.23) |  1.89\*\*\* (.22) |
| For profit sector (=1) | -6.09\*\*\* (.42) |  -5.89\*\*\* (.44) |  -1.75\*\*\* (.41) |
| Manufacturing and trade industry 1994 (=1) |  3.78\*\*\* (.50) |  3.06\*\*\* (.52) |  .60\*\*\* (1.07) |
| Adjusted R square |  .16 |  .07 |  .03 |
| N | 7800 | 7621 | 6703 |

|  |  |  |  |
| --- | --- | --- | --- |
| IVs | DV: 1994 Skill Level | DV: 1997 Skill Level | DV: 2003 Skill Level |
| Constant | 68.5\*\*\*(1.07) | 80.80\*\*\*(1.06) | 87.83\*\*\*(1.05) |
| White |  .26 (.51) |  -.04 (.50) |  .67 (.50) |
| Female | -4.28\*\*\* (.37) |  -4.78\*\*\* (.37) |  -5.98\*\*\* (.36) |
| Age when getting a BA degree |  .11\*\*\* (.03) |  .07\* (.03) |  .01 (.03) |
| Job related to major (1994 job)  |  6.22\*\*\*(.22) |  3.37\*\*\* (.22) |  1.94\*\*\* (.22) |
| For profit sector (=1) |  .31 (.41) |  .81\* (.41) |  1.75\*\*\* (.40) |
| Manufacturing and trade industry 1994 (=1) |  6.55\*\*\*(.49) |  4.51\*\*\* (.48) |  2.73\*\*\* (.48) |
| Adjusted R square |  .14 |  .07 |  .07 |
| N | 7800 | 7621 | 6703 |

|  |  |  |
| --- | --- | --- |
| IVs | DV: 1994 Cognitive Ability Level | DV: 2003 Cognitive Ability Level |
| Constant |  53.91\*\*\*(.56) | 65.28\*\*\*(.52) |
| White |  .15 (.26) |  .51\* (.25) |
| Female |  -1.63\*\*\*(.19) |  -1.93\*\*\*(.18) |
| Age when getting a BA degree |  .06\*\*\*(.01) |  .004 (.01) |
| Job related to major (1994 job)  |  3.9\*\*\* (.12) |  1.12\*\*\* (.11) |
| For profit sector (=1) |  .13 (.22) |  .20 (.20) |
| Manufacturing and trade industry 1994 (=1) |  2.06\*\*\*(.25) |  .28 (.24) |
| Adjusted R square |  .15 |  .03 |
| N | 7800 | 6703 |

|  |  |  |
| --- | --- | --- |
| IVs | DV: 1994 Knowledge Importance | DV: 2003 Knowledge Importance |
| Constant | 66.58\*\*\*(.57) | 73.68\*\*\*(.59) |
| White |  1.15\*\*\*(.27) |  1.28\*\*\*(.29) |
| Female |  -.30 (.20) |  -.02 (.20) |
| Age when getting a BA degree |  .06\*\*\*(.02) |  .04\* (.02) |
| Job related to major (1994 job)  |  3.18\*\*\*(.12) |  1.03\*\*\*(.12) |
| For profit sector (=1) |  -3.7\*\* (.22) | -2.15\*\*\*(.23) |
| Manufacturing and trade industry 1994 (=1) |  .81\*\* (.26) |  -.34 (.27) |
| Adjusted R square |  .17 |  .04 |
| N | 7800 | 6703 |

|  |  |  |
| --- | --- | --- |
| IVs | DV: 1994 Skill Importance | DV: 2003 Skill Importance |
| Constant | 83.46\*\*\*(.59) | 93.97\*\*\*(.57) |
| White |  .31 (.28) |  .61\* (.28) |
| Female | -1.64\*\*\* (.20) |  -2.41\*\*\*(.20) |
| Age when getting a BA degree |  .07\*\*\* (.02) |  .004 (.02) |
| Job related to major (1994 job)  |  3.21\*\*\* (.12) |  1.08\*\*\*(.12) |
| For profit sector (=1) | -1.53\*\*\* (.23) |  -.46\* (.22) |
| Manufacturing and trade industry 1994 (=1) |  2.74\*\*\* (.27) |  .63\* (.26) |
| Adjusted R square |  .12 |  .04 |
| N | 7800 | 6703 |

|  |  |  |
| --- | --- | --- |
| IVs | DV: 1994 Cognitive Ability Importance | DV: 2003 Cognitive Ability Importance  |
| Constant | 59.24\*\*\*(.33) | 66.01\*\*\*(.32) |
| White |  .14 (.16) |  .41\*\* (.16) |
| Female |  -.26\* (.11) |  -.28\* (.11) |
| Age when getting a BA degree |  .03\*\*\*(.01) |  -.01 (.01) |
| Job related to major (1994 job)  |  2.11\*\*\*(.07) |  .67\*\*\*(.07) |
| For profit sector (=1) |  -1.0\*\*\* (.13) |  -1.09\*\*\*(.12) |
| Manufacturing and trade industry 1994 (=1) |  .65\*\*\*(.15) |  -.44\*\* (.15) |
| Adjusted R square |  .15 |  .04 |
| N | 7800 | 6703 |

Relationships with the control variables are as one might expect: Older individuals have more experience in the labor market and therefore, other things equal, hold jobs with greater requirements. Women and non-whites consistently hold jobs with lower requirements, a pattern one sees in wage regressions. The relationships are in the same direction for K.S.& A. components and hold both for the level of K.S.A.’s and for their importance. Having a job related to one’s college major is related to every measure of KSA’s.

We turn now to our hypotheses:

**H:1a To what extent does academic ability measured in the form of SAT scores, affect career advancement? Does it provide an initial advantage in securing jobs with higher skill requirements?**

We consider the role of ability in career advancement using as our measure the scores of the respondents on SAT tests before they entered college. The tests are highly correlated with cognitive ability (the SAT was derived from the US Army’s IQ test) and reasoning skills, which is in part learned. (See Pascarella and Terenzini 2005 for an overview of SAT/ACT in the college context.) The OLS regressions include all the control variables above and add SAT scores as the independent variable.

The notion that cognitive ability is related to job performance, which in turn relates to advancement, is especially commonplace in industrial/organizational psychology, although how strong the relationship is has been the subject of considerable debate (see Richardson and Norgate 2015 for a recent review). Schmidt and Hunter (2004) assert that the general mental ability construct predicts advancement in occupations, close to the concern here. Similar arguments and evidence for such relationships have been made in economics (Boissiere, Knight, and Sabot 1985).

We begin by examining the relationship between SAT scores and KSA’s in the respondent’s first job in the data, in 1994.

To save space, the results in Table 3 report only the SAT coefficient outcomes and do so for six separate estimates. Higher SAT scores are positively related to the level of knowledge and skill that respondents had in their 1994 job and negatively related to the level and importance of ability required in that job. Because there are many channels through which the relationship with SAT’s could play out, the results here are effectively reduced form estimates. They show extensive relationships between the KSA’s of jobs required and SAT scores from tests taken before college:

Table 3: Summary of OLS Results Relating SAT’s to KSA’s In First Job

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: SAT | Adjusted R square | N |
| 1994 Knowledge Level |  .82\*\*\*(.19) | .16 | 6367 |
| 1994 Knowledge Importance |  .18+ (.10) | .16 | 6367 |
| 1994 Skill Level |  .76\*\*\*(.19) | .14 | 6367 |
| 1994 Skill Importance |  .18+ (.10) | .12 | 6367 |
| 1994 Cognitive Ability Level  |  .48\*\*\*(.10) | .16 | 6367 |
| 1994 Cognitive Ability Importance  |  .17\*\* (.06) | .14 | 6367 |

Note. The results shown above include all controls in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:2a Does academic ability provide a source of continuing advantage in securing jobs later on that have higher skill requirements?**

Here the analysis adds controls for KSA levels in the first job (1994) to see whether SAT scores continue to provide an additional advantage in subsequent jobs beyond the influence they may have through the first job. (In other words, the “Knowledge Level” equations for 1997 and 2003 include the knowledge level score for the 1994 job.)

Results for the K.S.A. level in 1994 not reported show that they have a strong and positive effect on subsequent jobs, a finding that is not surprising, but it does reinforce the importance of understanding the patterns among the sequence of jobs, which defines careers. The results in Table 4 for SAT’s are similar to those for initial advantage and are strongest and larger for 2003. One reason could simply be because more time has elapsed, which allows for more respondents to change jobs.

SAT scores have an effect on the skill levels of the jobs respondents held in 1997 and knowledge and skill levels as well as skill importance in 2003, in addition to any effects they had through the initial job in 1994.

Table 4: OLS Results Relating SAT’s to KSA’s Controlling for Initial KSA’s

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: SAT | Adjusted R square | N |
| 2003 | Knowledge Level |  .64\*\*\*(.17) | .10 | 5446 |
| Knowledge Importance |  -.03 (.10) | .13 | 5446 |
| Skill Level |  1.16\*\*\*(.17) | .14 | 5446 |
| Skill Importance |  .35\*\*\*(.10) | .08 | 5446 |
| Cognitive Ability Level  |  .57\*\*\*(.09) | .10 | 5446 |
| Cognitive Ability Importance |  .09 (.05) | .06 | 5446 |

Note. The results shown above have all controls in the equations as well as K,S,&A levels in 1994. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:3a Does academic ability provide a source of increasing advantage in securing jobs later on that have higher skill requirements?**

We examine this relationship with fixed effects estimates that examine whether the effects of SAT scores increase by year (year is coded 1=1994, 2=1997, 3=2003). A positive coefficient on that interaction term measures whether the relationship between SAT scores and KSA’s grows over time. These are fixed effects estimates, following the same respondent over time. The results in Table 5 suggest that it does for Skills and the level of cognitive ability.

Table 5: Fixed Effects OLS Results Relating SAT’s to KSA’s Over Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DV | SAT x Year | R square within | R square between | R square overall | N of observations |
| Knowledge Level |  .21 (.13) | .001 | .94 | .02 | 21504 |
| Knowledge Importance | -.002 (.07) | .0002 | .97 | .02 | 21504 |
| Skill Level |  .48\*\*\*(.12) | .008 | .98 | .04 | 21504 |
| Skill Importance |  .22\*\* (.07) | .002 | 1.00 | .04 | 21504 |
| Cognitive Ability Level  |  .23\*\*\*(.06) | .008 | .98 | .04 | 21054 |
| Cognitive Ability Importance |  .04 (.04) | .0005 | 1.00 | .05 | 21504 |

Note. The results shown above include SAT and Year in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:1b To what extent does socio-economic status affect career advancement? Does family background and college status create an initial advantage in securing jobs with higher skill requirements?**

The notion that one’s family background, especially those aspects related to family financial resources, affects the life outcomes of children is well established. The relationships come through a variety of channels from better social capital to more enriched family life and educational opportunities to inheritance. Ferrie (2005) reviews the related literature on occupational mobility across generations; Mitnik and Grusky (2015) review the specific literature on the socio-economic background of one’s family and subsequent career outcomes. They also provide new evidence that the magnitude of the relationship between one’s income and parents income is substantial.

In these estimates, we examine the relationship between the respondents’ family income before they enter college to the KSA’s of the job they held in 1994. Table 6 reports the relationship with the initial job respondents held in 1994. It is significant cognitive ability and importance and barely so for skill levels.

Table 6: Summary of OLS Results Relating Family Income to KSA’s In First Job

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: Family Income | Adjusted R square | N |
| 1994 Knowledge Level |  .39 (.61) | .16 | 7677 |
| 1994 Knowledge Importance |  .08 (.32) | .16 | 7677 |
| 1994 Skill Level | 1.38\* (.60) | .14 | 7677 |
| 1994 Skill Importance |  .54 (.33) | .12 | 7677 |
| 1994 Cognitive Ability Level |  .99\*\*(.31) | .15 | 7677 |
| 1994 Cognitive Ability Importance  |  .48\*\*(.19) | .15 | 7677 |

Note. The results shown above included all controls in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:2b Does socio-economic status provide a source of continuing advantage in securing jobs later on that have higher skill requirements?**

Here we examine whether family income and KSA’s have a continuing or marginal effect on the KSA’s held in jobs after 1994, so we control for 1994 KSA levels in the estimates. The effects reported in Table 7 are more widespread than for the initial job although why they should have an effect in 2003 and not in the first job and especially why they should have a marginal effect, controlling for 1994 levels, is surprising. Certainly it is supportive of the notion that the influence of socio-economic status continues after college.

Table 7: OLS Results Relating SAT’s to KSA’s Controlling for Initial KSA’s

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: Family Income | Adjusted R square | N |
| 2003 | Knowledge Level | 1.61\*\* (.57) | .10 | 6529 |
| Knowledge Importance |  .26 (.32) | .13 | 6529 |
| Skill Level | 2.06\*\*\*(.56) | .13 | 6529 |
| Skill Importance | 1.0\*\* (.31) | .08 | 6529 |
| Cognitive Ability Level  | 1.04\*\*\*(.28) | .10 | 6529 |
| Cognitive Ability Importance |  .37\* (.18) | .07 | 6529 |

Note. The results shown above include all controls in the equations and 1994 K, S, or A Level/Importance. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:3b Does socio-economic status provide a source of increasing advantage in securing jobs later on that have higher skill requirements?**

Table 8 reports fixed effects estimates for the relationship between family income and KSA’s in subsequent jobs to see if effects increase over time. There is no evidence for this hypothesis.

Table 8: Fixed Effects Results Relating Family Income to KSA’s Over Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DV | Family Income x Year | R square within | R square between | R square overall | N of observations |
| Knowledge Level |  .70+(.42) | .0004 | .91 | .02 | 25976 |
| Knowledge Importance |  .18 (.22) | .0001 | .96 | .02 | 25976 |
| Skill Level |  .17 (.40) | .001 | .98 | .03 | 25976 |
| Skill Importance |  .20 (.22) | .0006 | 1.00 | .04 | 25976 |
| Cognitive Ability Level | .05(.21) | .002 | .98 | .03 | 25976 |
| Cognitive Ability Importance | -.006(.12) | .001 | 1.00 | .04 | 25976 |

Note. The results shown above include Family Income and Year in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:1c Does social status in the form of the prestige of one’s college provide a source of initial advantage in securing jobs with higher KSA requirements?**

The idea that attending a more prestigious college confers benefits in the workplace is commonplace, and there is considerable evidence to back it up (e.g., Drewer, Eide, and Ehrenberg 1999). College quality and wage growth have been shown to be positively related from 1993 to 1997 with the B&B data set we use (Thomas and Zhang 2005). A recent study shows that the prestige of one’s undergraduate degree continues to affect career outcomes even after graduate school and controlling for the prestige of that graduate school (Hersh 2014).

In this section, we repeat the analyses above this time using the prestige of the college respondents graduated from as the independent variable. Because prestigious colleges attract and then select students with greater initial academic abilities, we add an additional control variable to these estimates - the SAT score of the respondent – to control for the greater initial academic ability of students in more elite colleges. The effects of the prestige variable is therefore more clearly a result of the college per se.

The results in Table 9 find widespread relationships with the KSA measures.

Table 9: Summary of OLS Results Relating College Prestige to KSA’s In First Job

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: College Prestige | Adjusted R square | N |
| 1994 Knowledge Level | 1.18\*\* (.42) | .16 | 6352 |
| 1994 Knowledge Importance |  .36 (.22) | .16 | 6352 |
| 1994 Skill Level | 1.36\*\* (.41) | .14 | 6352 |
| 1994 Skill Importance |  .58\* (.23) | .12 | 6352 |
| 1994 Cognitive Ability Level |  .77\*\*\*(.21) | .16 | 6352 |
| 1994 Cognitive Ability Importance |  .30\* (.13) | .14 | 6352 |

Note. The results shown above had all controls in the equations and SAT scores. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:2c Does college prestige provide a source of advantage in securing jobs that have higher skill requirements later on?**

We estimate in Table 10 the marginal effects of college prestige for subsequent jobs by adding control variables for KSA’s in 1994. The positive, marginal effects of college prestige operate across K.S.&A. levels in 2003.

Table 10: OLS Results Relating College Prestige to KSA’s Controlling for Initial KSA’s

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: College Prestige | Adjusted R square | N |
| 2003 | Knowledge Level |  .85\* (.39) | .10 | 5433 |
| Knowledge Importance |  .06 (.21) | .13 | 5433 |
| Skill Level |  1.13\*\* (.38) | .14 | 5433 |
| Skill Importance |  .30 (.21) | .08 | 5433 |
| Cognitive Ability Level |  .65\*\* (.19) | .10 | 5433 |
| Cognitive Ability Importance |  .08 (.12) | .06 | 5433 |

Note. The results shown above include all controls and SAT scores as well as 1994 K, S, or A Level/Importance. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:3c Does college prestige provide a source of increasing advantage**

Table 11 reports fixed effects estimates examining the relationship between college prestige and KSA outcomes over time. Here the results suggest that the relationship does increase in its importance over time for K.S.&A. levels:

Table 11: Fixed Effects Results Relating College Prestige to KSA’s Over Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DV | College Prestige x Year | R square within | R square between | R square overall | N of observations |
| Knowledge Level |  .60\* (.26) | .0006 | .92 | .02 | 26390 |
| Knowledge Importance |  .14 (.14) | .0002 | .96 | .02 | 26390 |
| Skill Level |  .83\*\*\*(.24) | .003 | .98 | .03 | 26390 |
| Skill Importance |  .33\* (.13) | .0006 | 1.00 | .04 | 26390 |
| Cognitive Ability Level  |  .46\*\*\*(.13) | .003 | .98 | .03 | 26390 |
| Cognitive Ability Importance |  .10 (.07) | .0001 | 1.00 | .04 | 26390 |

Note. The results shown above had College Prestige and Year in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

Finally, we consider the role of prior achievement on advancement into roles with greater KSA demands. We examine that in the form of success in classroom learning through cumulative grade point averages. As with the prestige of the college one attends, ability may play a substantial role in academic achievement, so we add SAT scores to the control variables. This measure presumably captures knowledge acquired in college, but it also may be a proxy for effort, given the usual view that achievement is a function of ability, which we control for, and effort.

**H:1d Does prior achievement, in the form of academic achievement, affect career advancement? Do graduates with higher grades secure initial job with higher requirements?**

There are many reasons for thinking that better performance in college should be related to more career success. Better grades suggest greater learning and higher levels of knowledge acquired; better grades also suggest the exercise of greater effort, which might be dispositional and continue in the workplace; more generally, given that past performance is related strongly to future performance, we might expect that success in one arena should be associated with success in another. Chia and Miller (2008) found that academic performance in Australia was related to starting salaries. Whether those results translate to the US where there is greater variation in how grading works is not so clear. The research in psychology examining the relationships between grades (mainly in high school) and actual job performance argues for a relationship, but it is correlational, fom 0.16 to 0.30 with various corrections (Roth et al 1996), which implies that it explains little of the variation in job performance. More recently, Diette and Raghav (2016) find a negative relationship between college grades and salaries.

The results in Table 12 report relationships between grades and KSA’s of initial jobs in 1994. Here the results are surprising: Academic achievement in the form of higher college grades is associated with holding initial jobs with lower skill and ability requirements.

Table 12: Summary of OLS Results Relating College Prestige to KSA’s In First Job

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: GPA | Adjusted R square | N |
| 1994 Knowledge Level | -.005 (.005) | .16 | 6182 |
| 1994 Knowledge Importance | -.001 (.002) | .16 | 6182 |
| 1994 Skill Level | -.02\*\*\*(.005) | .15 | 6182 |
| 1994 Skill Importance | -.01\*\*\*(.003) | .12 | 6182 |
| 1994 Cognitive Ability Level | -.01\*\*\*(.002) | .16 | 6182 |
| 1994 Cognitive Ability Importance | -.004\*\*(.001) | .14 | 6182 |

Note. The results shown above include all controls and 1994 SAT scores.

**H:2d Does prior achievement have a continued effect on job requirements in subsequent jobs?**

Table 13 reports relationships between college grades and subsequent KSA’s controlling for the KSA’s of the respondents’ initial job in 1994. The results in 2003 generally show no relationships. To test for the possibility of regression to the mean effects, we also include here the results for jobs held in 1997. There is evidence here of that effect as relationships went from negative between grades and K.S.A. requirements in 1994 to positive for the change in job requirements between 1994 and 1997. By 2003 there is essentially no relationship with the change in requirements over the 1994 to 2003 period. A simple explanation for these results in Tables 12 & 13 is that respondents start out in jobs with lower KSA’s, begin to catch up later on, and by 2003, the marginal effect of better grades no longer matters.

Table 13: OLS Results Relating GPA’s to KSA’s Controlling for Initial KSA’s

|  |  |  |  |
| --- | --- | --- | --- |
| DV | IV: GPA | Adjusted R square | N |
| 1997   | Knowledge Level |  .02\*\*\* (.004) | .21 | 5980 |
| Knowledge Importance |  .008\*\* (.002) | .24 | 5980 |
| Skill Level |  .003 (.004) | .18 | 5980 |
| Skill Importance |  .003 (.002) | .14 | 5980 |
| Cognitive Ability Level |  .005\* (.002) | .18 | 5980 |
| Cognitive Ability Importance |  .004\*\*\*(.001) | .14 | 5980 |
| 2003 | Knowledge Level |  .02 (.004) | .10 | 5294 |
| Knowledge Importance |  .003 (.002) | .13 | 5294 |
| Skill Level | -.01+ (.004) | .14 | 5294 |
| Skill Importance | -.003 (.002) | .08 | 5294 |
| Cognitive Ability Level |  .002 (.002) | .10 | 5294 |
| Cognitive Ability Importance |  .003\* (.001) | .06 | 5294 |

Note. The results shown above had all controls in the equations, SAT scores, and 1994 K, S, or A Level/Importance. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**H:3d Does achievement in college provide a source of increasing advantage in securing jobs later on that have higher skill requirements? Does the same relationship hold for initial placement in jobs requiring greater KSA’s?**

Table 14 reports fixed effects estimates. The signs for knowledge and skills are negative, although none of the relationships approach standard levels of significance.

Table 14: Fixed Effects Results Relating GPA to KSA’s Over Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DV | GPA x Year | R square within | R square between | R square overall | N of observations |
| Knowledge Level | -.003 (.003) | .004 | .91 | .02 | 25644 |
| Knowledge Importance | -.001 (.001) | .006 | .95 | .02 | 25644 |
| Skill Level | -.0004(.002) | .0001 | .98 | .03 | 25644 |
| Skill Importance | -.0001(.001) | .0002 | 1.00 | .04 | 25644 |
| Cognitive Ability Level  |  .02 (.001) | .001 | .98 | .03 | 25644 |
| Cognitive Ability Importance |  .001 (.001) | .005 | 1.00 | .04 | 25644 |

Note. The results shown above had GPA and Year in the equations. +p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

**Conclusions**:

Despite the importance of understanding careers to individuals, employers, and society, we have little systematic information about what they look like, especially in open labor markets where individuals change employers. The main challenge in doing so is to establish a criterion for comparing jobs in order to assess whether advancement has taken place. A strong case can be made that job requirements are the most salient criterion to use. The contribution here is to bring job requirements into the analysis of career advancement as a means to address the previously intractable challenge that using position in an organizational hierarchy is not useful in the contemporary context of movement across employers.

The descriptive results outlining the basic facts as to how job requirements change for individuals over the first 10 years of their post-college career offer some surprises. First, the requirements of the jobs held by our respondents did not change dramatically in the first decade of their career. During the same time period, the real earnings of the respondents, adjusting for inflation, roughly doubled (NCES 2008). Even though K.S.A. requirements are correlated with income for recipients, it seems difficult to suggest that rising wages reflect mainly changes in job requirements.

The idea that career advancement puts a premium on continuing education, especially in the STEM fields, is not obviously supported by these results. The knowledge requirements of jobs, associated with education, do not increase any faster than the skill components, associated with experience. Engineering and technical skills show the smallest increase.

In terms of the hypothesis concerning cumulative advantage, some of the most interesting as well as consistent findings come from variables that we used as controls. Groups we might see as traditionally disadvantaged in the labor market – women and non-whites – systematically held jobs with lower requirements, more so for women. Having a job that connects to one’s major is also related to securing jobs with higher KSA requirements across virtually all analyses. Whether that is because jobs with higher skill requirements require educational preparation or that some jobs make better use of the skills that individuals bring with them – better matches with academic experiences - is difficult to say. Supporters of the non-profit work will be pleased to note that job requirements seem to be greater, other things equal, for respondents working in that sector of the economy.

In terms of the cumulative advantage story, the fact that the resources we observe before one enters the post-college workforce have some influence on workplace outcomes is generally well-established, although for some, such as college grades, the direction of the effects remains in doubt. The contribution here is first to examine relationships on a new attribute of career success – the level of skill requirements jobs entail – and second, to examine the effects over time.

The main conclusion is that the initial resources that new college grads bring to the job market do more than help them gain an initial job that demands more from them. Those resources help them move up faster to bigger jobs after they get into the labor force, and in some cases, the boost those initial advantages give them actually increase in importance over time.

The most important resource here arguably is SAT scores, a proxy for cognitive ability. It is associated with initial jobs having greater requirements, it has an additional effect on securing later jobs with greater requirements, and the effects tend to increase over time. The prestige of one’s college, controlling for the academic ability of the respondents, has a similar, reasonably consist association with job requirements: greater for initial jobs, an additional effect on subsequent jobs, and an increasing effect over time.

Socio-economic status in the form of family income seems to have something of a delayed effect, being more important in the increase in subsequent jobs than in the respondent’s initial job. Academic achievement in the form of college grades shows a pattern consistent with regression to the mean effects. Perhaps disappointing to faculty but not inconsistent with at least some of the prior research, graduates with higher grades start out in jobs with lower requirements, although they move to jobs with higher requirements relatively quickly. The effect of grades does not persist, however, which makes them the only one of the three resources considered here that is not really consistent with the notion of cumulative advantage.

There are many limitations to the analysis about that are associated with studying cumulative advantage. The main issue concerns the concept itself, which is about the nature of relationships between resources and life outcomes rather than about a particular mechanism that relates a given resource to a given outcome. As such, the cumulative advantage story is like a reduced-form analysis that includes all possible mechanisms within a relationship and does not try to sort them out. The challenge of omitted variables that has to be met to sort out specific mechanisms is not a consideration here.

These limitations are less of a concern in this context where we are using a new measure to examine the broad question of cumulative advantage, which includes examination of three different types of relationships and four different types of initial resources. Many of them have been and each could be by themselves the subject of separate publications that try to isolate a particular mechanism through which effects occur and then establish a clear causal path to that relationship.

The standard concern about identification may be more of an issue concern here. The fact that the entire sample are college graduates who left college at the same time addresses some selection issues and that the resources are measured years before the outcomes helps somewhat in establishing causation.

Serious problems remain for efforts to establish causation, of course, such as whether knowledge about job requirements affects students’ choices concerning college. But for the purposes of examining cumulative advantage, such concerns are less of a problem because the hypotheses are ultimately about association rather than causation: The fact that attending a more prestigious college has an increasing association with job outcomes over time, for example, is the point for cumulative advantage. For other hypotheses, it is important to be able to identify whether such colleges attract more able students, whether students who want more serious jobs make different college decisions, and so forth. Clearly those are important questions for social science, but the questions examined here matter as well.

**Bibliography**

Allison PD, Long JS, Krauze TK. 1982. Cumulative advantage and inequality in science. *American Sociology Review.* 47:615–25

Ang, S., S. Slaughter, K. Y. Ng. 2002. Human capital and institutional determinants of information technology compensation: Modeling multilevel and cross-level interactions. Management Sci. 48(11) 1427–1445. Employer attributes and rewards.

Arnold, J. (1994). Opportunity for***skill***use,***job***changing, and unemployment as predictors of psychological well-being amongst graduates in early career. Journal of Occupational and Organizational Psychology, 67, 355–370.

[Atkins, Stephen G.](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Atkins%2C%2BStephen%2BG./%24N?accountid=14707) 2012. Career planning: The role of work analysis in the work of your organization's career development manager.  In *The handbook of work analysis: Methods, systems, applications and science of work measurement in organizations*, by Wilson, Mark A. (Ed); Bennett, Winston, Jr. (Ed); Gibson, Shanan G. (Ed); Alliger, George M. (Ed),  491-511. New York, NY, US:Routledge/Taylor & Francis Group, 2012.

Barley, S. R. (1989). Careers, identities, and institutions: The legacy of the Chicago school of sociology. In D. T. Hall, B. S. Lawrence,& M. B. Arthur(Eds.),The Handbook of Career Theory.Cambridge: Cambridge University Press, 41-60.

Becker, Gary. 1964. Human Capital. Chicago: University of Chicago Press.

Bidwell, Matthew; Briscoe, Forrest. 2010. [The Dynamics of Interorganizational Careers.](http://proxy.library.upenn.edu:2095/ehost/viewarticle?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bVJrqqxT66k63nn5Kx95uXxjL6nrke3pbBIr6ueULiosFKwr55Zy5zyit%2fk8Xnh6ueH7N%2fiVbGmrkiyq7NLrpzqeezdu33snOJ6u%2bHjgKTq33%2b7t8w%2b3%2bS7TbGutk2uqa4%2b5OXwhd%2fqu37z4uqM4%2b7y&hid=4212)

Organization Science. 21(5): 1034-1053.

Bidwell, Matthew, Won, Shinjae, Barbulescu, Roxana and Mollick, Ethan. (2015). I Used to Work at Goldman Sachs! How Organizational Status Creates Rents in the Market for Human Capital. Strategic Management Journal.

Bidwell, Matthew J. and Mollick, Ethan. (2015). Shifts and Ladders: Comparing the Role of Internal and External Mobility in Executive Careers. Organization Science.

Biemann, Torsten, Anette E. Fasang, and Daniela Grunow. 2011. “Do Economic Globalization and Industry Growth Destabilize Careers? An Analysis of Career Complexity and Career Patterns over Time.” Organization Studies 32:1639–63.

Blau, Peter M., and Otis Dudley Duncan. 1967. The American Occupational Structure. New York: John Wiley.

Bothner, **Matthew** S., Podolny, Joel M., and Smith, Edward Bishop. 2011 Organizing Contests for Status: The **Matthew** **Effect** vs. the Mark **Effect.** Management Science. Mar2011, Vol. 57 Issue 3, p439-457.

Bowles, S., Gintis, H., & Osborne, M. (2001). Incentive-enhancing preferences: Personality behavior and earnings. The American Economic Review, 91, 155–158.

Brannick, M.T., Levine, E.L., & Morgeson, F.P. (2007). Job and work analysis: methods, research and applications for human resource management (2nd ed.). Thousand Oaks, CA: Sage.

Brewer, Dominic J., Eric R. Eide, Ronald G. Ehrenberg. 1999. Does It Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings. The Journal of Human Resources, 34(1): 104-123.

Briggs, Elten, Jaramillo, Fernando, and Weeks, William A.2012. Perceived barriers to career advancement and organizational commitment in sales. Journal of Business Research. 65(7): 937-943..

Bright, Jim, E.H., Robert G.L. Pryor, Eva Wing Man Chan, Jeniyanti Rijanto. 2009. Chance events in career development: Influence, control and multiplicity Journal of Vocational Behavior 75 (2009) 14–25

Breen, Richard, and Jan O. Jonsson. 2007. “Explaining Change in Social Fluidity: Educational Equalization and Educational Expansion in Twentieth-Century Sweden.” American Journal of Sociology 112:1775–810.

Cheng, Siwei. 2014. A Life Course Trajectory Framework for Understanding the Intracohort Pattern of Wage Inequality. American Journal of Sociology. 2014, Vol. 120 Issue 3, p633-700.

Chong, Eric. 2013. Managerial Competencies and Career Advancement: A Comparative Study of Managers in Two Countries. Journal of Business Research. 66: 345-353.

Chia, Grace and Paul W. Miller. “Tertiary Performance, Field of Study, and Graduate Starting Salaries. The Australian Economic Review. 2008, 41(1), pp. 15-31.

Converse, Patrick D. et al. 2004. Matching Individuals to Occupations and Jobs Using the O\*Net: Issues and an Application in Career Guidance Personnel Psychology. 57: 451-487.

[Converse, Patrick D.](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Converse%2C%2BPatrick%2BD./%24N?accountid=14707) and [Oswald, Frederick L.](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Oswald%2C%2BFrederick%2BL./%24N?accountid=14707). 2004. The effects of data type on job classification and its purposes. 2004. [Psychology Science](http://proxy.library.upenn.edu:2187/psycinfo/pubidlinkhandler/sng/pubtitle/Psychology%2BScience/%24N?accountid=14707)[46.1](http://proxy.library.upenn.edu:2187/psycinfo/indexingvolumeissuelinkhandler/23494/Psychology%2BScience/02004Y01Y01%24232004%243b%2B%2BVol.%2B46%2B%24281%2429/46/1?accountid=14707) (2004): 99-127.

Corona, Victor. 2011. Career Patterns in the U.S. Army Officer Corps. Public Organization Review. Jun2011, Vol. 11 Issue 2, p109-134.

### Damian, Rodica Ioana; Rong Su; Shanahan, Michael; Trautwein, Ulrich; Roberts, Brent W. [Can Personality Traits and Intelligence Compensate for Background Disadvantage? Predicting Status Attainment in Adulthood.](http://proxy.library.upenn.edu:2310/ehost/viewarticle?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bVJrqqxT66k63nn5Kx95uXxjL6nsEevrK1KrqezOK%2bnuEu2sLFOnsbLPvLo34bx1%2bGM5%2bXsgeKzq0mxqLFOsqevTK6c6nns3bt97Jziervh44Ck6t9%2fu7fMPt%2fku0mur65PrquxTaTc7Yrr1%2fJV5OvqhPLb9owA&hid=4212) Journal of Personality & Social Psychology. Sep2015, Vol. 109 Issue 3, p473-489

Diette, Timothy M.and Manu Raghav. 2016. A Student's Dilemma: Is There a Trade-Off between a Higher Salary or Higher GPA. *Education Economics* 24(6): 612-621.

Dries, Nicky, Roland Pepermans, Olivier Carlier. 2008. Career success: Constructing a multidimensional model Journal of Vocational Behavior 73 254–267.

DiPrete, Thomas A. 1987. Horizontal and Vertical Mobility in Organizations. Administrative Science Quarterly 32(3): 422-444.

DiPrete, Thomas A., and Gregory M. Eirich. 2006. “Cumulative Advantage as a Mechanism for Inequality: A Review of Theoretical and Empirical Developments.” Annual Review of Sociology 32:271–97.

Duncan, G. and Duniform, R. (1998), “Soft skills and long-run labor market success”, Research in Labor Economics, Vol. 17, pp. 123-50.

Ferrie, Joseph P. 2005. History Lessons The End of American Exceptionalism? Mobility in the United States Since 1850.Journal of Economic Perspectives. 19(3): 199-215.

Fligstein, N. (1991). The structural transformation of American industry: An institutional account of the causes and consequences of diversification in the largest firms, 1919-1979. In W.W. Powell & P. J. DiMaggio (Eds.), The new institutionalism in organizational analysis (pp. 311-336). Chicago: University of Chicago Press.

Gelissen, J., & de Graaf, P. M. (2006). Personality, social background, and occupational career success. Social Science Research, 35, 702–726.

Gorman, Elizabeth H. and Julie Kmec. 2009. [Hierarchical Rank and Women's Organizational Mobility: Glass Ceilings in Corporate Law Firms.](http://proxy.library.upenn.edu:2812/ehost/viewarticle/render?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bVJrqqxT66k63nn5Kx95uXxjL6nrUytqK5JtZa3Uq6muEq1lr9lpOrweezp33vy3%2b2G59q7TLantUmyp65KpOLfhuWz44ak2uBV3%2bbmPvLX5VW%2fxKR57LOySLOoslG3q6R%2b7ejrefKz5I3q4vJ99uoA&vid=4&sid=0445b4fd-d093-4236-bee4-850cbcd18594@sessionmgr4008&hid=4101" \o "Hierarchical Rank and Women's Organizational Mobility: Glass Ceilings in Corporate Law Firms. ) American Journal of Sociology. 114(5): 1428-1474.

Gupta, Nina G. and Douglas Jenkins, Jr. 1991. Job Evaluation: An Overview. Human Resource Management Review. 2:1 91-95

Handel, Michael J. 2016. The O\*NET content model: strengths and limitations. Journal of Labour Market Research. 49:157–176

[Hege, Jerry W.](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Hedge%2C%2BJerry%2BW./%24N?accountid=14707); Walter C [Borman,](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Borman%2C%2BWalter%2BC./%24N?accountid=14707) and Mark J. [Bourne](http://proxy.library.upenn.edu:2187/psycinfo/indexinglinkhandler/sng/au/Bourne%2C%2BMark%2BJ./%24N?accountid=14707) 2006. Designing a system for career development and advancement in the U.S. Navy [Human Resource Management Review](http://proxy.library.upenn.edu:2187/psycinfo/pubidlinkhandler/sng/pubtitle/Human%2BResource%2BManagement%2BReview/%24N?accountid=14707)[16(3):](http://proxy.library.upenn.edu:2187/psycinfo/indexingvolumeissuelinkhandler/23494/Human%2BResource%2BManagement%2BReview/02006Y09Y01%2423Sep%2B2006%243b%2B%2BVol.%2B16%2B%24283%2429/16/3?accountid=14707)340-355.

Heimler, Ronald, Stuart Rosenberg, and Elsa-Sofia Morote.2012. Predicting career advancement with structural equation modeling. Education and Training.54(2/3):85-94.

Hersh, Joni. 2014. Catching Up Is Hard to Do: Undergraduate Prestige, Elite Graduate Programs, and the Earnings Premium. [*Vanderbilt Law and Economics Research Paper No. 14-23*](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2473238##).

Hughes,E. C. 1937. Institutional office and the person. American Journal of Sociology,43(3):404--413.

Joslyn, Carl S. and Frank W. Taussig. 1932. American Business Leaders, New York: MacMillian.

Mobility

Judge, T. A., Cable, D. M., Boudreau, J. W., & Bretz, R. D. (1995). An empirical investigation of the predictors of executive career success. Personnel Psychology, 48: 485–519.

Kanter, R. M. (1977). Men and women of the corporation. NewYork: Basic Books

Leuze, Katherine. 2007. What Makes for a Good Start? Consequences of Occupation-Specific Higher Education for Career Mobility: Germany and Great Britain International Journal of Sociology, 37(2): 29-53.

Loher, Brian T.; Noe, Raymond A.; Moeller, Nancy L.; Fitzgerald, Michael P. 1985. A meta-analysis of the relation of job characteristics to job satisfaction. Journal of Applied Psychology, 70(2): 280-289.

Markham, W.T., Harlan, S.L., & Hackett, E.J. (1987). Promotion opportunity in organisations. *Research in Personnel and Human Resources Management* (pp. 223-287). New York JAI Press.

Mayer, Karl Ulrich, and Glenn R. Carroll. 1987. “Jobs and Classes: Structural Constraints on Career Mobility.” European Sociological Review 3:14–38.

Merton RK. 1973a. The Matthew effect in science. In The Sociology of Science, ed. NW Storer, pp. 439–59. Chicago: Univ. Chicago Press

Merton RK. 1988. The Matthew effect in science, ii: cumulative advantage and the symbolism of intellectual property. Isis 79:606– 623

Manroop, Laxmikant; Richardson, Julia. 2016. [Job Search: A Multidisciplinary Review and Research Agenda.](http://proxy.library.upenn.edu:2812/ehost/viewarticle/render?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bVJrqqxT66k63nn5Kx95uXxjL6nrUytqK5JtZa3Uq6muEq1lr9lpOrweezp33vy3%2b2G59q7TLantUmyp65KpOLfhuWz44ak2uBV4OrmPvLX5VW%2fxKR57LOvSbKqsU63prI%2b5OXwhd%2fqu37z4uqM4%2b7y&vid=11&sid=0445b4fd-d093-4236-bee4-850cbcd18594@sessionmgr4008&hid=4101" \o "Job Search: A Multidisciplinary Review and Research Agenda. ) International Journal of Management Reviews. 18(2): 206-22.

McGuinness, S. 2006. “Overeducation in the Labour Market.” Journal of Economic Survey 20 (3): 387–417.

Mitnik, Pablo and David B. Grusky. 2015. Economic Mobility in the United States. Pew Charitable Trusts and the Russell Sage Foundation. http://www.pewtrusts.org/~/media/assets/2015/07/fsm-irs-report\_artfinal.pdf

NCES. 2008. Ten Years After College: Comparing the Employment Experiences of 1992–93 Bachelor’s Degree Recipients With Academic and Career Oriented Majors. Table 12. Washington, D.C. National Center for Educational Statistics. <https://nces.ed.gov/pubs2008/2008155.pdf>

Newcomer, Mabel. 1955. The Big Business Executive: The Factors that Made Him, 1900-1950. New York:Columbia University Press.

Nicholson, N., & De Waal-Andrews, W. (2005). Playing to win: Biological imperatives, self-regulation, and trade-offs in the game of career success. Journal of Organizational Behavior, 26, 137–154.

Manzonni, Anna. Social Forces.

Oxford Dictionary online accessed December 2016. <https://en.oxforddictionaries.com/definition/skill>

OECD. 2016. Survey of Adult Skills (PIAAC). Paris. http://www.oecd.org/skills/piaac/

Pinnington, Ashly H. Competence development and career advancement in professional service firms. Personnel Review. 2011, Vol. 40 Issue 4, 443-465.

Richard, Ken and Sarah H. Norgate. 2015. Does IQ Really Predict Job Performance? [Appl Dev Sci](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4557354/). 2015 Jul 3; 19(3): 153–169.

Robert G.L. Pryor and Jim E.H. Bright 2007. Applying Chaos Theory to Careers: Attraction and attractors Journal of Vocational Behavior 71: 375–400

Robst, J. (2007), “Education and job match: the relatedness of college major and work”, Economics of Education Review, Vol. 26 No. 4, pp. 397-407.

.

Roth, Philip L.; BeVier, Craig A.; Switzer III, Fred S.; Schippmann, Jeffery S. 1996. Meta-analyzing the relationship between grades and job performance. Journal of Applied Psychology. 81(5): 548-556.

Rubenstein, I., and Y. Weiss. (2006): “Post Schooling Wage Growth: Investment, Search and Learning,” in Handbook of the Economics of Education, ed. by E. Hanushek, and F. Welch, vol. 1 of Handbook of the Economics of Education, chap. 1, pp. 1–67. Elsevier.

Schein, E. H. Career dynamics: Matching individual and organizational needs. Addison-Wesley: Reading, 1978.

Slocum Jr., John W., Hurley, Amy E., Fagenson-Eland, Ellen A., Sonnenfeld, Jeffrey A., .1997. Does Cream Always Rise to the Top? An Investigation of Career Determinants Organizational Dynamics, Vol. 26, Issue 2.

Stewman, S. and S.L. Konda. 1983.Careers and organizational labor markets: demographic models of organizational behavior. American Journal of Sociology. 88:637–85.

Tharenou, P. (in press). Managerial career advancement. In C.L. Cooper and I.T. Robertson (Eds.), *International Review of Industrial and Organizational Psychology.* New York: Wiley.

Thornton, P and W. Ocasio. 1999. Institutional logics and the historical contingencyof power in organizations: Executive succession in the higher education publishing industry, 1958-1990. American Journal of Sociology.105(3): 801-843.

Tippins, Nancy T. and Margaret L. Hilton. Eds. 2010. A Database for a Changing Economy: Review of the Occupational Information network (O\*NET). Washington, D.C.: National Academies Press.

Thomas, Scott and Liang Zhang. 2005. Post-Baccalaureate Wage Growth within Four Years of Graduation: The Effects of College Quality and College Major. Research in Higher Education. 46(4): 437-459.

Thorndike, EL (1920), "A constant error in psychological ratings", Journal of Applied Psychology, 4(1): 25-29.

Topel, Robert H. (1991): “Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority. Journal of Political Economy 99(1): 145-176.

Walmsley, Philip T., Natali, Michael W., and Campbell, John P. 2012 Only Incumbent Raters in O\* NET? Oh Yes! Oh No! International Journal of Selection & Assessment. Sep2012, Vol. 20 Issue 3, p283-296.

White House. 2016. Fact Sheet: New Steps to Advance Equal Pay on the Seventh Anniversary of the Lilly Ledbetter Fair Pay Act. Washington, D.C.: Office of the Press Secretary. https://obamawhitehouse.archives.gov/the-press-office/2016/01/29/fact-sheet-new-steps-advance-equal-pay-seventh-anniversary-lilly

Willis, Richard J. "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions." Chapter 10 in The Handbook of Labor Economics. Vol. 2. Edited by Orley Ashenfelter, and Richard Layard. North Holland, 1987.

Wilson, M. (2007). A history of job analysis. In L. Koppes, Historical perspectives in industrial and organizational psychology. Mahwah, NJ: Lawrence Erlbaum Associates.

Zuckerman H. 1988. Accumulation of advantage and disadvantage: the theory and its intellectual biography. In Robert K. Merton and Contemporary Sociology, eds. C Mongardini, S Tabboni, pp. 139–62. New York: Trans. Publishers.

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**Appendix:**

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| --- | --- | --- | --- |
|  | Mean | SD | N |
| White | .86 | .004 | 6169 |
| Female | .55 | .01 | 6169 |
| Age when getting a BA degree | 23.38 | .05 | 6169 |
| Job related to major (1994 job)  | 2.26 | .01 | 6169 |
| For profit sector (=1) | .63 | .01 | 6169 |
| Manufacturing and trade industry 1994 (=1) | .19 | .005 | 6169 |
| SAT/ACT - index | 2.46 | .01 | 6169 |
| Family income | .52 | .004 | 6169 |
| College prestige | .48 | .006 | 6169 |
| GPA – 400 point scale | 302.96 | .63 | 6169 |

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| --- | --- | --- | --- |
|  | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Level of KSA | 257.43 | 45.08 | 8359 | 266.53 | 42.12 | 9505 | 270.84 | 38.00 | 8585 |
| Importance of KSA | 287.56 | 25.00 | 8359 | 291.83 | 23.42 | 9505 | 295.53 | 21.96 | 8585 |

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| --- | --- | --- | --- |
|  | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Level of Abilities | 104.69 | 20.02 | 8359 | 105.52 | 19.58 | 9505 | 106.08 | 18.19 | 8585 |
| Importance of Abilities | 122.23 | 11.96 | 8359 | 122.42 | 11.69 | 9505 | 123.20 | 11.07 | 8585 |
| Level of Knowledge | 68.08 | 17.52 | 8359 | 72.27 | 17.19 | 9505 | 73.58 | 14.63 | 8585 |
| Importance of Knowledge | 73.98 | 9.17 | 8359 | 75.92 | 9.06 | 9505 | 76.81 | 8.18 | 8585 |
| Level of Skills | 84.66 | 16.94 | 8359 | 88.75 | 15.85 | 9505 | 91.18 | 14.56 | 8585 |
| Importance of Skills | 91.35 | 9.27 | 8359 | 93.48 | 8.47 | 9505 | 95.51 | 7.87 | 8585 |

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| --- | --- | --- | --- |
| Level of Knowledge | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Business and management | 17.64 | 5.09 | 8358 | 18.61 | 4.99 | 9504 | 19.11 | 5.49 | 8584 |
| Social sciences | 16.91 | 6.95 | 8358 | 18.13 | 7.16 | 9504 | 18.66 | 6.63 | 8584 |
| Engineering and technology  | 12.22 | 6.55 | 8358 | 12.93 | 6.59 | 9504 | 12.69 | 6.44 | 8584 |
| Science | 10.44 | 5.07 | 8358 | 10.93 | 5.26 | 9504 | 11.40 | 5.19 | 8584 |
| Liberal arts | 7.06 | 2.86 | 8358 | 7.57 | 3.04 | 9504 | 7.69 | 2.78 | 8584 |
| Communication | 3.81 | 1.38 | 8358 | 4.09 | 1.42 | 9504 | 4.03 | 1.4 | 8584 |

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| --- | --- | --- | --- |
| Importance of Knowledge | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Social sciences | 16.95 | 4.39 | 8358 | 17.52 | 4.49 | 9504 | 18.06 | 4.58 | 8584 |
| Business and management | 16.74 | 3.00 | 8358 | 17.20 | 2.95 | 9504 | 17.31 | 3.22 | 8584 |
| Engineering and technology  | 14.11 | 3.82 | 8358 | 14.45 | 3.81 | 9504 | 14.30 | 3.77 | 8584 |
| Science | 13.06 | 3.02 | 8358 | 13.24 | 3.15 | 9504 | 13.57 | 3.29 | 8584 |
| Liberal arts | 8.56 | 1.65 | 8358 | 8.78 | 1.68 | 9504 | 8.92 | 1.76 | 8584 |
| Communication | 4.56 | 0.91 | 8358 | 4.73 | 0.93 | 9504 | 4.66 | 0.91 | 8584 |

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| --- | --- | --- | --- |
| Level of Skills | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Basic | 32.78 | 5.47 | 8358 | 34.34 | 5.00 | 9504 | 35.16 | 4.34 | 8584 |
| Social | 19.28 | 2.97 | 8358 | 19.97 | 2.81 | 9504 | 20.53 | 2.58 | 8584 |
| Technical | 11.02 | 7.24 | 8358 | 11.5 | 7.46 | 9504 | 11.53 | 7.36 | 8584 |
| Resource management  | 9.39 | 3.16 | 8358 | 9.95 | 3.11 | 9504 | 10.42 | 3.31 | 8584 |
| System | 8.97 | 2.18 | 8358 | 9.61 | 2.06 | 9504 | 10.06 | 1.89 | 8584 |
| Complex problem solving | 3.22 | 0.56 | 8358 | 3.38 | 0.54 | 9504 | 3.48 | 0.50 | 8584 |

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| --- | --- | --- | --- |
| Importance of Skills | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Basic | 32.31 | 3.27 | 8358 | 33.13 | 2.99 | 9504 | 34.00 | 2.82 | 8584 |
| Social | 19.07 | 2.29 | 8358 | 19.36 | 2.26 | 9504 | 19.81 | 2.12 | 8584 |
| Technical | 17.81 | 4.33 | 8358 | 17.97 | 4.35 | 9504 | 18.08 | 4.22 | 8584 |
| Resource management  | 10.10 | 1.8 | 8358 | 10.42 | 1.46 | 9504 | 10.62 | 1.9 | 8584 |
| System | 8.83 | 1.38 | 8358 | 9.23 | 1.3 | 9504 | 9.56 | 1.22 | 8584 |
| Complex problem solving | 3.24 | .39 | 8358 | 3.37 | .37 | 9504 | 3.45 | .38 | 8584 |

|  |  |  |  |
| --- | --- | --- | --- |
| Level of Ability | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Cognitive | 64.12 | 8.94 | 8358 | 66.28 | 8.23 | 9504 | 67.52 | 7.21 | 8584 |
| Sensory | 22.25 | 4.43 | 8358 | 22.62 | 4.41 | 9504 | 22.68 | 4.09 | 8584 |
| psychomotor | 11.47 | 8.03 | 8358 | 10.72 | 8.11 | 9504 | 10.31 | 7.85 | 8584 |
| physical | 6.85 | 7.23 | 8358 | 5.90 | 6.93 | 9504 | 5.56 | 6.40 | 8584 |

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| --- | --- | --- | --- |
| Importance of Ability | 1994 | 1997 | 2003 |
| Mean | SD | N | Mean | SD | N | Mean | SD | N |
| Cognitive | 64.39 | 5.26 | 8358 | 65.62 | 4.69 | 9504 | 66.83 | 4.5 | 8584 |
| Sensory | 26.92 | 2.69 | 8358 | 27.06 | 2.7 | 9504 | 27.14 | 2.54 | 8584 |
| psychomotor | 17.53 | 5.23 | 8358 | 16.98 | 5.25 | 9504 | 16.70 | 4.92 | 8584 |
| physical | 13.39 | 4.65 | 8358 | 12.76 | 4.42 | 9504 | 12.53 | 4.06 | 8584 |

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1. See http://govcentral.monster.com/benefits/articles/7413-the-importance-of-ksas-knowledge-skills-and-abilities-in-the-federal-application-process [↑](#footnote-ref-1)
2. A detailed description of the sampling methodology and outcomes is provided in NCES Chapter 2 (2005). Use of the B&B data is restricted by NCES and requires a site license. [↑](#footnote-ref-2)