Exploration for Human Capital: Evidence from the MBA Labor Market*

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Abstract

We document that firms consider potential employees using a real options approach, similar to when making physical capital investment decisions. Using novel data from the labor market for MBA graduates, we show that uncertainty regarding job candidates' productivity hinders hiring, and that firms value probationary employment arrangements that provide the option to learn more about potential full-time hires. The detrimental effect of uncertainty on investment in new employees is more pronounced when firms face higher turnover costs or weaker competition, but, unlike in the case of physical investments, it does not depend on the job candidates' general redeployability.

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1 Introduction

Human capital is a critical asset for firms, yet the process by which companies decide whom to hire is still not well understood. However, the decision to invest in people is similar to the decision to invest in physical assets, as both types of investments are generally made under uncertainty regarding their future productivity. Here we combine insights from the finance literature on real options and from the labor and personnel economics literature on employer-employee matching and job search to conduct an empirical analysis of the process by which firms select employees.[1]

Our analysis documents patterns in investment in workers that are similar to those characterizing investment in physical assets. We find that uncertainty regarding the productivity of potential employees has a negative effect on the firms' decision to hire. Corporations value temporary employment arrangements that provide the option to learn about the productivity of workers before making long-term hiring decisions. The hindering effect of uncertainty on corporate hiring is more pronounced when employee turnover costs are higher, and when firms face less competition, and it does not depend on the general ability, or redeployability, of the job candidates.

These effects are similar to those shown by the extensive literature on real options in corporate investment, whose focus has been on physical assets. Specifically, theoretical work regarding investment decisions has found that it is valuable for firms to wait and learn more about future product market conditions before starting or abandoning a project (Brennan and Schwartz (1985), Titman (1985), and McDonald and Siegel (1986)). The option to wait for the resolution of uncertainty is more valuable for investments with a higher degree of irreversibility, which may come from higher capital adjustment costs or a lower degree of asset redeployability, and for firms operating in less competitive markets (Williams (1993), Grenadier (2002)). These predictions have been verified empirically in the context of real estate valuation and development (Quigg (1993), Cunningham (2007), Bulan, Mayer and

[1]See Oyer and Schaefer (2011) for details about the successes and limitations of the economics literature on employer/employee matching. For empirical evidence on firm/worker matching focused on senior executives, see Bandiera, Guiso, Prat and Sadun (2010) and Graham, Harvey and Puri (2010). They show that firms that offer stronger incentives employ managers who are more risk tolerant and more talented, and that managerial characteristics such as risk aversion match these firms' project types. Kaplan, Klebanov and Sorensen (forthcoming) document that personality characteristics influence firms' choice of executives and correlate with performance.

Somerville (2009)), offshore petroleum lease acquisitions (Paddock, Siegel and Smith (1988)), mining operations (Moel and Tufano (2002)), and manufacturing (Guiso and Parigi (1999)). Hence, our results indicate that firms use similar considerations when investing in people as they do when investing in physical assets, as both of these inputs to production are characterized by uncertainty.

Our empirical setting is the labor market for MBA graduates. In our sample, a large fraction of job applicants have unknown industry fit, which creates uncertainty regarding their future productivity. We document that employers value the option to learn about candidates lacking industry experience by making significant use of cheap probationary employment – namely, summer intern positions after the students' first year in the MBA program. The interest in exploring workers with unknown fit is significantly higher at the internship recruiting stage, when revealed poor matches can be dissolved at no cost, relative to the full-time recruiting stage which occurs in the students' second year of MBA study. Firms that are particularly concerned about uncertainty in employee productivity when making hiring decisions are those likely to have high turnover costs, such as small companies, and those which do not face strong competition for workers. A job candidate's general ability, which is similar to the general redeployability of a physical asset, does not diminish the negative effect of uncertainty regarding industry fit on the likelihood of being hired. This is expected, because, unlike the case of physical assets, firms do not own (and can not sell) the human capital granted by a person's high general ability or redeployability, and therefore can not recover the costs associated by hiring a worker who later is revealed to be a poor match.

Probationary or temporary employment arrangements similar to the summer internships we consider are widespread and continue to gain importance. This type of employment has been shown to be a stepping stone to permanent employment, accounting for a significant percentage of jobs across the world: for example, 10% in the U.K. (Booth, Francesconi and Frank (2002)) and 35% in Spain (Guell and Petrongolo (2007)). Using U.S. survey data, Houseman (2001) reports that temporary and part-time workers are employed by 46% and 72% of business establishments, respectively. While providing firms with flexibility to weather changes in the economic environment (Segal and Sullivan (1997), Levin (2002)), temporary and contract employment is also valued for offering firms the option to learn about the quality of workers. In the U.S. survey sample constructed by Houseman (2001), 21% of employers using temporary workers from agencies and 15% using part-time workers

cite screening as an important reason for using these types of work arrangements.

In this paper we focus on a specific form of employee uncertainty – the unknown degree to which an individual will be a good fit for a firm's industry. There are other characteristics of workers that may be uncertain, including general ability traits that cannot be fully determined in the hiring process and the degree to which a potential hire fits the specific firm that considers hiring her. We focus on industry fit uncertainty because we can measure the degree to which a candidate's fit with a particular industry is known by firms, and because we observe significant variation in the data regarding industry fit uncertainty, as well as hiring outcomes.

Human and physical capital investments, while quite similar, differ in the nature of their uncertainty. Typically, the source of uncertainty about physical capital investments comes from future demand in the product market. For example, an oil exploration firm is concerned with whether future oil prices will be high or low, and may want to wait for less uncertain times before incurring the exploration costs. Therefore, variability in such settings has an intertemporal nature. In human capital investments, concerns about uncertainty regarding product market demand may be of lesser importance relative to concerns about the inherent heterogeneity of human capital. This leads us to focus on the option to learn as the firm determines the value of the asset (i.e., the employee) over time rather than on the option to wait for information revelation in the product market.[2]

Few prior papers have studied firms' strategic choice about how much risk to take when hiring. A seminal paper in this area is Lazear (1998), which presents a model of the option to learn in a labor market context, and states conditions under which hiring risky workers can be a profit-maximizing strategy for firms. Given the institutional context we study empirically, our approach differs from Lazear (1998) in a few key ways. We focus on industry-specific productivity and study an empirical setting where firms post and pay the same wage to all employees. Our data and empirical approach allow us to address the comment by Oyer and Schaefer (2011) that there is scarce work examining across-firm variation in the propensity

[2]Kahn and Lange (2011) point out a type of employee heterogeneity that is more analogous to the option to wait in real option models of physical capital by considering the fact that workers' productivity is constantly changing and that these changes differ across people. This suggests that firms might value both the option to learn and the option to wait on employees as they do with other assets (see Grenadier and Malenko (2010)), so that they can see how a given worker's productivity develops. However, because our empirical analysis focuses (due to data availability) on the initial firm/worker match, we cannot analyze this form of option value.

to hire risky workers, or whether the observed variation fits with Lazear's theory.[3] While few labor economics papers have studied how much and why firms choose to hire workers with uncertain productivity, much of the extant labor literature takes it as a given that firms take substantial risks when hiring workers. For example, our work builds on the large literatures regarding matching and employer learning. However, while most prior work focuses on firms learning about an employee's ability or the quality of the match to the firm, we focus on workers' match to an industry. Our work is inspired by the classic Jovanovic (1979) matching model, the learning model in Farber and Gibbons (1996), and the idea in Prescott and Visscher (1980) that organization capital is enhanced by the ability to learn more about workers' characteristics, before assigning them to specific production tasks, by observing their performance in an apprenticeship-like endeavor.

Getting a better understanding of the matching process in high-skill environments such as the one studied here is important, given the increasing prevalence of graduate degrees and the significant role of high-skill and professional labor markets in the economy. The process of matching firms and employees early in their career is also particularly interesting to study, in light of the strong impact of these initial matches on long-term employment and productivity (Oyer (2008)). Our empirical results provide some guidance on what employers are searching for in at least one high-talent market.[4]

Our paper also complements the emerging finance literature regarding the role of workers on corporate decisions and outcomes. For example, the firms' workforce characteristics have been shown to influence capital structure choices, theoretically and empirically (e.g., Berk, Stanton and Zechner (2010), Agrawal and Matsa (2011)), as well as the cost of capital (Eisfeldt and Papanikolaou (forthcoming)). The acquisition of productive labor, not just physical assets, is an important driver of M&A decisions (Ouimet and Zarutskie (2011)).

We discuss the underlying conceptual framework that motivates our analysis in section

[3]See Bollinger and Hotchkiss (2003) and Hendricks, DeBrock and Koenker (2003) for examples from sports markets.

[4]Data on MBA graduates has recently been used in other economics and finance research. For example, Shue (2011) finds that networking through MBA education leads executives to exhibit commonalities in firm policies. Sapienza, Maestripieri and Zingales (2009) show that MBA students low in risk aversion are more likely to work in higher risk finance jobs after graduation, while Kaniel, Massey and Robinson (2010) find that optimistic MBA students receive job offers faster than their peers. Ahern, Duchin and Shumway (2013) find positive peer effects in risk aversion among MBA students, while Malmendier and Lerner (forthcoming) document MBA peer effects in entrepreneurial pursuits.

2 of the paper. We describe the data set and the key features of our empirical setting in sections 3 and 4. Section 5 contains the empirical analysis, as well as a discussion of its limitations. Section 6 concludes.

2 Conceptual framework

We now motivate the empirical work to follow by laying out an intuitive conceptual framework to match the setting we analyze. Our data come from a two-year full-time MBA program. The vast majority of students have a work history from before their time in the MBA program, work at a summer internship in the summer between the two years of the program, and take a full-time job upon graduation. Internships give summer employers an opportunity to learn about the students before making a commitment for full-time employment.

Consider a potential hire whose productivity at a firm is increasing in each of three attributes. First, the person will be more productive if his general ability, which we will measure through grades, is higher. Second, the person will be more productive if his skills and interests are a good match for the industry in which the firm operates. Finally, there is an idiosyncratic firm-worker match component driven, for example, by how well the person fits with the other workers of the firm or with the firm's strategies. Employers can learn important things along all these dimensions during an internship. However, given that firms already have a significant amount of information about the person's academic success, which we interpret as a proxy for general ability, internships are especially likely to be informative about industry and idiosyncratic match quality. We believe that learning along both these dimensions during the summer internship is valuable to firms. However, we only have the ability to empirically study learning about industry fit, and hence we focus our analysis on this dimension.

Specifically, our data allow us to quantify the uncertainty regarding the fit between a potential employee and a firm's industry. We observe the pre-MBA jobs of the students in our sample, and hence we can measure the degree of experience that a job candidate has with the industry of the firm to which they are applying. The uncertainty about the candidate's industry fit can be low, in the case of people who have worked in the specific, narrowly-defined industry of the firm. For example, this would be the case of a student previously employed

by an investment bank who applies for a job with another investment bank recruiting on campus. The uncertainty could be high in the case of candidates who have not worked in organizations that, broadly speaking, belong to the same industry as that of the firm they are applying to. This would be the case of somebody whose entire work experience is in consulting, but is now applying to a job in investment banking. Finally, the uncertainty regarding industry fit could be moderate, when the candidate has previously worked in the same broadly-defined industry. For example, this would happen when a candidate previously employed by a commercial bank now applies to an investment banking position. In other words, we are able to classify each applicant to a particular job as being characterized by either low, medium or high uncertainty regarding their fit with the industry of the firm posting that job.

Our predictions regarding the effect of general ability on a student's job market prospects are straight-forward: we expect students with better grades to be more attractive in the job market. This should be true at both the summer internship and permanent hiring stages. Hence we expect better academic performance to have a positive effect on the probability of an interested student getting a job offer from a given firm.

Our predictions about the role of uncertainty in firms' hiring decisions follow from several assumptions about this labor market. (A simple theoretical model yielding the empirical predictions tested here was part of a prior version of this paper, and can be found on the authors' research web sites.) Specifically, we assume that having pre-MBA experience in the industry of a hiring firm indicates that the job applicant is likely to be a good fit for that industry. We also assume it is detrimental for a firm to hire a person who is a poor industry fit because the employee will be unproductive and firing and replacing the person will be costly. Moreover, the cost of hiring a bad fit is likely lower for summer interns than for permanent hires because the firm can simply choose not to continue the employment relationship at the end of the summer. Perhaps most controversially, we assume that firms offer the same wage to all people to whom they offer jobs. This is a strong assumption in that it precludes the labor market clearing through wage competition. As we show below, we can justify this in our context, as employers generally offer the same wage to all new MBA hires, and post these wages prior to observing the candidate pool.

Under these assumptions, consider a firm deciding to whom it should make offers. At either the summer internship or full-time hiring stage, the firm will always prefer higher

general ability candidates and will prefer industry stayers to industry switchers. But consider an investment bank choosing between two candidates. One candidate is a solid student with a proven track record in banking. The other candidate has outstanding academic credentials and appears to have been successful in non-finance positions before business school. How will a firm make the ability-versus-experience choice?

We expect firms to tip the balance somewhat towards focusing on general ability and away from industry experience in certain situations. Specifically, firms will take more risks in summer hiring. That is, the lack of industry experience will be less of a factor for summer hiring than for full-time hiring. Moreover, firms with higher turnover costs will value industry experience relatively highly. When firms face a lot of competition for workers, we expect them to not be as concerned about employee uncertainty. Rather than wait for the resolution of uncertainty, but likely face a pool of candidates of lower quality during later stages of recruiting, firms faced with strong competitors should be more inclined to take risks on uncertain workers. And, finally, since firms do not own employees' human capital, the negative effect of uncertainty about industry fit on hiring should not be reduced for candidates with high levels of general ability, or redeployability.

Our empirical analysis tests these predictions about the role of uncertainty regarding job applicants' industry fit on the decisions of firms to hire.

3 Data

We use a novel dataset describing detailed aspects of the recruiting process conducted by a large number of globally-known firms at a top business school in the U.S. The data span three MBA cohorts during 2007-2009, encompassing 1,482 job applicants and 383 firms, covering both internship and full-time recruiting. The data include details regarding the firms' identity and industry, job openings posted, as well as the candidates' personal and work background, MBA coursework completed, applications sent during both recruiting stages, and offers received. Importantly, we also know the grade point average (GPA) of these individuals while in business school, which provide us with a proxy for their general ability. See Kuhnen (2011) for more details regarding the dataset. Table 1 provides basic summary statistics for these job candidates and firms.

We describe firms using various measures of industry, size and prestige. We use a coarse

breakdown of industry, putting firms into one of six categories – consulting, finance, general corporations, technology, government/non-profit and other services (mainly law firms), as well as a fine classification scheme, based on the 60-industry breakdown used by the business school providing the data. We measure firm size based on either annual revenues, or the number of employees. These figures are collected from Compustat in the case of publicly-traded firms, and from databases compiled by Hoovers, Manta.com, and Vault.com in the case of private firms. We measure firm prestige in two ways. First, we classify a firm as prestigious if it is listed in the *Fortune MBA 100* annual rankings during 2007-2009.[5] The second way to classify a firm as prestigious is if it receives above-median bids for interview slots during on-campus recruiting from job candidates.

We use firm size and prestige to capture two characteristics that have been previously shown to influence the impact of uncertainty on corporate investment decisions, namely, turnover costs and competition. The hindering role of uncertainty on investment has been shown to be increased by turnover, or capital adjustment costs, (e.g., McDonald and Siegel (1986)), and diminished by competition (e.g., Grenadier (2002)). To proxy for firms' turnover cost, we use firm size, as smaller firms are likely to face higher costs if they need to fire and replace employees. For example, smaller firms may not have a dedicated human resources department, they may be less able to redeploy workers in different divisions (see Tate and Yang (2011)), or they may be more financially constrained and thus more likely to fire workers following changes in project choices (Giroud and Mueller (2012)). To measure the strength of competition for workers faced by firms, we use firm prestige, since this characteristic captures the ease with which a company's offers are accepted by potential employees. For example, we observe that offers made by firms on the *Fortune* list have a significantly higher chance to be accepted than offers made by other firms: 52% versus 40% in the case of internships, and 61% versus 44% in the case of full-time jobs (these differences are significant at $p < 0.01$).

The recruiting process at the business school providing the data for this study is well structured. It unfolds in a series of steps. 1) The recruiting process begins during the first-year of the two-year MBA program when students submit resumes (at no cost) to companies that will offer on-campus recruiting for summer internships, indicating they would like the company to interview them. 2) Employers select some of these students, known as the "closed" interviewing list. 3) Then an "open" or "bidding" phase takes place. Students bid

[5]The rankings are available at: http://money.cnn.com/magazines/fortune/mba100/2009/full_list/.

points from their annual endowment of 800 to obtain an interview slot. Given the scarcity of bid points, getting an open interview is costly. 4) The firm interviews those chosen on the closed list and those who bid enough points to get on the open list, and after these interviews, the firm makes offers to some students. 5) Each student then accepts or rejects the offer. 6) At some point after the summer internship, the firm may make the student an offer to return to a full-time position upon graduation.

The process (steps 1-6) then repeats for the second-year students applying for full-time post-MBA positions. Those who participate in the full-time recruiting stage include most students who did not get an offer to return to their summer employer (at least not as of the start of the on-campus recruiting season) and those who got an offer but want to continue to explore alternatives.

The data we have on this process includes which students applied to which openings through both the open and closed systems, how many points each student bid when applying for an open interview, whether or not the person got an offer from each job to which they applied, which offer the student accepted, and whether each summer internship led to a full-time offer. Unfortunately, we do not see data on intermediate steps such as whether a student was selected for a closed interview or how many rounds of interviews a student completed.

On-campus recruiting for full-time positions begins near the start of the second year of the MBA program. On-campus recruiting for summer internships occurs primarily from January to March of the first year in the program. 100% of the students in the three cohorts studied here used the on-campus recruiting process, either for internships or full-time jobs, so we need not be concerned that the job applicants we study represent an unusual subsample.

4 Important features of the empirical setting

The first key feature in the data is that firms offer a single wage for any given position. This implies that wages offered for jobs taken upon finishing school do not depend on individual ability or industry experience. An institutional detail driving this feature is that employers that recruit on campus are required to post details such as the job title, location, and salary at the very beginning of the recruiting season (and before seeing any candidates). As shown in the regression model in Table 2, the data confirms that starting salaries (i.e.,

those characterizing the first year of employment after graduate school) are specific to the position available, and do not depend on characteristics of the person who receives the employment offer.[6] Specifically, controlling for class, industry, job source, job location, and company-job title fixed effects, we find no evidence that the GPA, quality of undergraduate institution attended, industry experience, age, gender, or international student status of the person receiving the full-time offer are related to the offered wage (either in logs or levels). Furthermore, in the data only 10.8% of starting full-time wages are renegotiated, and the corresponding figure for internships is 1.72%.[7]

The second key data feature for our analysis is that many applicants will have unknown industry fit, creating uncertainty regarding their future productivity. We observe that among all applications sent for jobs, the fraction that come from individuals who have not worked in the narrowly-defined (i.e., using the 60-category classification scheme created by the school) industry of the hiring firm is 89%. For full-time jobs, the corresponding fraction is 86%. This illustrates the fact that for the majority of potential candidates, firms face uncertainty regarding industry-specific fit.

The third important feature is that firms make significant use of the probationary employment channel, i.e., internships, which offers them the ability to learn about the candidates' future productivity at low cost. The vast majority (94%) of students work in a probationary position during the summer between the first and second year of the MBA program, and 44% of candidates who receive probationary employment convert that into full-time job offers. In 68% of these cases, the offer is accepted.

Finally, internships are used, at least in part, to learn about industry-fit uncertainty, because we see that interns who are industry switchers have a 19% lower chance of convert-

[6]We only have data concerning starting salaries. It is likely that after working for a company for a while, an employee will be compensated based on proven performance. The flexibility to lower wages post-hiring may lower adjustment costs for firms and therefore may ease the hiring of risky workers.

[7]Not surprisingly, the wage renegotiation frequency is 3.7% higher in the case of male candidates, in line with the finding in Babcock and Laschever (2003) that men are better than women at asking for higher pay. In a different sample of MBA students, Bertrand, Goldin and Katz (2010) document a rising gap in earnings between men and women after graduation, caused by gender differences with respect to training during business school, career interruptions, and weekly hours worked. While in general rare, renegotiations of starting wages are more frequent for cohorts graduating during good economic times, compared to those graduating during recessions. Specifically, the frequency of renegotiations is 13.01% for the class of 2007, and 8.27% for the class of 2009 (the difference is statistically significant at $p < 0.05$). The renegotiation frequency for the class of 2008 (graduating several months before the beginning of the financial crisis in September 2008) is 10.02%.

ing the summer job into a full-time offer, relative to industry stayers. Furthermore, these unsuccessful industry switching interns are 38% more likely to apply to a different industry at the full time stage. In other words, internships reveal those with poor industry fit, and thus are channel for reducing uncertainty regarding employees' productivity.

5 Results

5.1 Uncertainty hinders investment

We find that uncertainty hinders investment, at both the internship and the full-time recruiting stages. Figure 1 shows that the success rate of job applications decreases monotonically with the level of uncertainty regarding the industry fit of the candidate, at both recruiting stages.

At the internship stage, the fraction of applications that result in offers is 8.37%, 6.54% and 4.96% among applicants characterized by low, medium, and, respectively, high uncertainty regarding their fit with the industry of the hiring firm. These success rates of applications are significantly different from each other ($p < 0.01$), and indicate that firms are most reluctant to hire those individuals who have the least exposure to their industry, and hence, who have the highest level of uncertainty regarding whether or not they would be a good fit for that industry.

A similar pattern is observed during full-time recruiting. At that stage, the fraction of applications that result in offers is 6.65%, 3.53% and 2.97% among applicants characterized by low, medium, and, respectively, high uncertainty regarding their fit with the industry of the hiring firm. These rates are significantly different from each other at ($p < 0.01$). Once again, we observe that firms are the least inclined to invest in applicants with the highest degree of uncertainty regarding industry fit. Furthermore, within each level of job seekers' uncertainty, the application success rate is significantly lower during full-time recruiting, relative to the internship stage ($p < 0.01$).

While these results suggest that uncertainty hinders hiring decisions, other interpretations are possible and must be investigated. For example, people with less experience in the industry of the firm to which they apply – for short, industry switchers – may have lower general ability, or other characteristics that make them less desirable to employers. It is also

possible that there are more industry switching candidates in particular cohorts graduating at times when firms do not hire as much, for example during recession years. Moreover, industry switching candidates may tend to apply to industries with fewer jobs available, or, within an industry, to firms with a lower capacity to hire.

We account for these potential confounds in the econometric models in Table 3. There, we estimate three models predicting the likelihood that a job application results in an offer: a linear probability model, a logistic regression showing odds ratios effects, and a GLM model indicating risk ratios effects, with the goal of identifying the effect of the candidate's uncertainty about industry fit on their likelihood of success. As control variables, we include the candidates' GPA, which is our proxy for their general ability, as well as indicator variables for gender and international student status (the latter may influence hiring decisions due to work-visa concerns). We also include cohort fixed effects, as well industry fixed effects. Moreover, we control for the number of interview slots available to applicants for each specific job opening, as a way to account for the firms' capacity to hire.

As shown by the results in Table 3, even after accounting for these confounding factors in hiring decisions, we continue to observe a very strong negative effect of industry fit uncertainty on the likelihood that an application will result in the firm making an offer. Using the logistic regression specification, which is the easiest to interpret, we find that medium uncertainty candidates and high uncertainty candidates have 65%, and 53%, respectively, as high odds of receiving an offer as those candidates characterized by low uncertainty about industry fit. Hence the odds of hiring success are almost halved for individuals with the highest level of industry fit uncertainty, relative to those characterized by the least uncertainty. These effects are significant at $p < 0.01$ and are common across all three empirical specifications in the table. Also in accordance with the results in Figure 1, we find that the odds of applications resulting in offers are indeed significantly higher (e.g., 137% as high, using the logistic estimation) at the internship stage relative to the full-time recruiting stage.

As expected, Table 3 also shows that high general ability employees are more sought after, all else equal. Increasing a candidate's GPA by 1 point (say, from 3.00 to 4.00, approximately a four standard-deviations increase) leads to 318% higher odds that the application will result in an offer, using the logistic regression specification.

The results in Table 3 indicate that, controlling for several firm and applicant characteristics that may be important for hiring decisions, we observe that higher uncertainty

regarding the applicants' industry fit lessens the chance that firms will hire them. In other words, uncertainty about productivity hinders corporate investment in people, similar to the effects previously documented in the case of investment in physical assets. We now turn to analyzing whether differences in the turnover costs or competition faced by firms, and in the general ability or redeployability of candidates, impact the role of uncertainty on hiring in ways that also parallel the effects documented in the context of physical investments.

5.2 Uncertainty hinders investment more when firms face higher turnover costs

The first approach to understanding whether uncertainty is more detrimental to hiring when firms face higher turnover costs is to determine whether the lack of information about a candidate's industry fit reduces the odds of success of their application more at the full-time stage, when the costs of dissolving a poor match are high, than at the internship recruiting stage, when these costs are negligible.

The logistic regression in Table 4 presents evidence consistent with this implication. The goal of the econometric model is to identify the differences in the odds that an application results in a job offer across the three levels of uncertainty about industry fit, and across the two recruiting stages. The analysis includes the same set of firm and job applicant controls as used in Table 3. The reference category refers to applications coming from individuals characterized by low uncertainty about industry fit, at the internship recruiting stage. Our prior results suggest that this category of applications should have the highest odds of success, and the results in the table confirm that is indeed the case. Also, we observe that the detrimental effect of uncertainty on hiring decisions is significant at each of the two recruiting stages, separately. At the internship stage, the odds of success of a high uncertainty applicant are 57% as high as those of a low uncertainty candidate ($p < 0.01$), while at the full-time recruiting stage, the odds of success of a high uncertainty applicant are only 43% as high (i.e., the ratio of coefficients 0.41 and 0.95 in the table) as those of a low uncertainty candidate ($p < 0.01$). These two effects are significantly different at $p < 0.01$. In other words, the reluctance of firms to hire people with high, relative to low, uncertainty about industry fit is particularly pronounced at the full-time recruiting stage, when arguably the costs of firing and replacing a poor match are much higher than at the internship stage.

The second approach to testing whether higher turnover costs increase employers' reluctance to hire candidates with uncertain industry fit is to study differences across firms in hiring decisions. It is likely more difficult for small firms to bear the cost of hiring and eventually replacing a person who proves to be a bad match. Hence in the logistic regression in Table 5 we estimate the relative odds of application success across the three levels of uncertainty about industry fit, and across below- and above-median firms, by size. Firm size is measured by sales in Panel A, and by the number of employees in Panel B. The analysis includes the same set of firm and job applicant controls as used in Table 3. Using both measures of firm size, we find that the lowest interest in hiring is for high uncertainty candidates who apply to small firms. All of the other types of applicants have significantly higher odds of success. For example, high uncertainty candidates applying to large firms have between 127% ($p < 0.05$) and 135% ($p < 0.01$) as high odds as those applying to small firms, depending on the proxy used for firm size. In other words, high uncertainty job seekers are not disadvantaged as much when applying to large firms. Also, in line with our prior results, we observe that within each firm size category, the interest in hiring decreases monotonically with the level of the candidates' uncertainty.

5.3 Competition among firms lessens the effect of uncertainty on investment

We now turn to examining whether firms that face more competition for employees will be less concerned about candidates' uncertainty regarding industry fit, and hence, more likely to hire riskier workers. In Table 6 we estimate the effect of uncertainty on hiring decisions as a function of firm prestige, which is our proxy for whether the firm faces low or high competition for workers. A firm is labeled as prestigious if it was included in the *Fortune MBA 100* annual rankings during 2007-2009 (Panel A), or if it receives above-median bids for interview slots from job candidates (Panel B). The analysis includes the same set of firm and job applicant controls as used in Table 3.

The logistic regression models in Table 6 show that, within prestige category, higher uncertainty lowers the odds of offers, as expected. Moreover, the applicants whose odds of success are significantly smaller than the odds of everybody else are those with high uncertainty regarding industry fit who apply to prestigious firms, which face the least competition.

For example, using the specification in Panel B, high uncertainty candidates applying to non-prestigious firms have 136% as high odds as those applying to prestigious firms ($p < 0.01$). As a baseline, we note that among low uncertainty candidates, the odds of success for those applying to non-prestigious firms are 118% (the ratio of coefficients 2.33 and 1.98) as high as for those applying to prestigious firms ($p < 0.01$).

A necessary condition for competition to speed up investment and lessen the delaying effect of uncertainty is that firms that wait longer before making hiring decisions will be faced with a lower quality pool of potential workers. Table 7 documents that the quality of job applicants is in fact lower at the full-time recruiting stage relative to the internship stage. The overall GPA of 307 candidates who choose not to participate in on campus full-time recruiting is 3.50, whereas the GPA of the 1100 who participate is 3.44 (the difference is significant at $p < 0.001$). This indicates that, at least along this dimension of general ability, the full-time recruiting pool is of lower quality than the pool of candidates who are no longer seeking jobs at that time (the 0.06 GPA difference represents approximately a quarter of one standard deviation). To understand whether there is also a worsening of the candidate pool at the full-time recruiting stage in terms of industry experience, we calculate the percentage of candidates who participate in the on-campus full-time recruiting process, conditional on being an industry switcher at the internship stage. Of those who choose not to apply for full-time jobs in their second year of the MBA program (21% of candidates), 80% had interned for companies in an industry (using the school's 60 industry categorization scheme) different from that where they worked before business school, and therefore were industry switchers in the first recruiting stage. For the remaining candidates, who did apply to jobs during the on-campus recruiting process, 85% were industry switchers at the internship stage (the difference is significant at $p < 0.03$). Among all candidates recruiting at the internship stage, 84% were industry switchers. Therefore, the pool of candidates actively seeking jobs at the full-time recruiting stage is of lower quality, in terms of industry experience, than the pool of candidates who have completed the job seeking process after the summer internship stage. These results indicate that there exists some unraveling in terms of general ability and industry expertise during the two recruiting stages.

5.4 General ability (asset redeployability) does not lessen the effect of uncertainty on investment

In the case of investment in physical assets, firms are not as concerned about uncertainty regarding these assets' future productivity if they are characterized by higher redeployability. For example, this happens if firms can sell the assets at high prices later on, recovering their initial investments, if the uncertainty is resolved in an unfavorable manner. In the case of hiring workers, whose human capital is not owned or sellable by firms, a higher degree of redeployability, or general ability, should not lessen the effect of uncertainty on hiring decisions. Indeed, this is what we observe in the data, as shown by the results in Table 8. We measure general ability using the person's grades while in the MBA program, and we characterize each student as having either a high or a low GPA, depending on whether their GPA is above or below the median. The results in Panel A show that among high GPA students, the odds of an application resulting in an offer are 50% as high for applicants with high uncertainty relative to those with low uncertainty about industry fit ($p < 0.01$). Panel B shows a similar effect among low GPA students: the odds of an application resulting in an offer are 54% as high for applicants with high uncertainty relative to those with low uncertainty about industry fit ($p < 0.01$). Hence, as predicted, the wedge in firms' preference for low versus high uncertainty candidates does not get smaller for higher general ability candidates.

6 Conclusion

We show that firms consider potential employees using a real options approach, similar to when making other types of investment decisions. Our analysis is based on a unique dataset covering MBA recruiting activity at a top U.S. business school. We find that firms value probationary employment arrangements that provide the option to learn about the productivity of potential hires before permanent investment occurs. Higher uncertainty regarding employee productivity hinders hiring, more so when turnover costs are higher, or when firms face weaker competition. Job candidates' general ability, which is a similar characteristic to asset redeployability in the context of physical investments, does not diminish the negative effect of uncertainty on firms' hiring decisions. This is not surprising, because, unlike in the

case of physical investments, firms do not own the human capital conferred by the general ability or redeployability of hired personnel, and hence can not recover the costs associated with the hiring of individuals who are later revealed to be poor matches.

We should note that, while our analysis allows us to draw some conclusions regarding the role of uncertainty in hiring decisions, the data have limitations that lead to caveats about the internal and external validity of our results. First, even though the career office at the school that provided the data works very hard to encourage students to provide details of their offers, it is possible that students may report their market outcomes with some error, such as not listing all offers. Second, a substantial amount of the job search by students at this school is done through channels other than on-campus recruiting. In these cases, we do not have any information about firms' preferences because we do not observe who applies to these firms. While we do not think that these issues bias our results substantially (if anything, the measurement error would imply any relationships in the data are likely to be stronger than our analysis suggests), we do not know for sure. Third, the external validity of our analysis is limited by the fact that our data set covers job seekers at one school and the particular firms that choose to conduct recruiting activities there.

While these limitations are important, high-skill labor markets such as the one we study are growing in importance in developing countries. Also, there has been limited empirical work analyzing the matching process between firms and workers. Therefore, we believe our analysis makes a useful contribution by showing that real options considerations are an important component of corporate hiring decisions.

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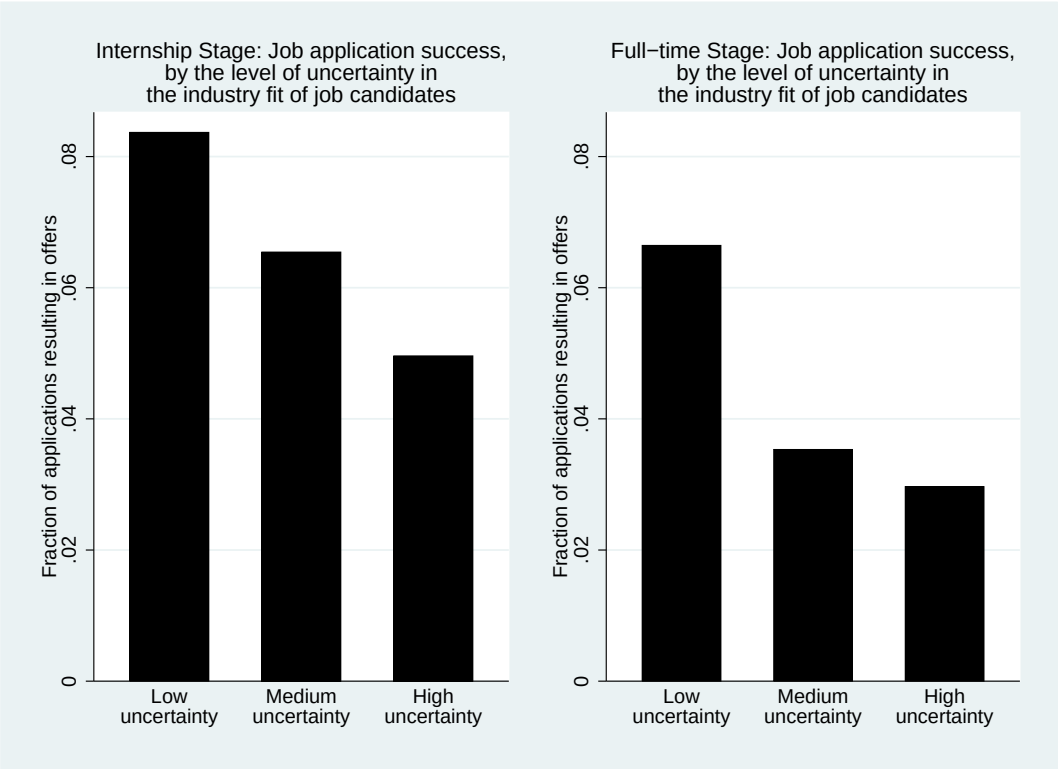


Figure 1: Fraction of applications resulting in job offers, by the level of uncertainty in candidates' industry fit.

Table 1: Summary statistics for job candidates and firms.

Panel A: Job candidates ($N = 1482$)	
Male	65.80%
International student	39.13%
Attended Top 100 college	48.33%
GPA	Mean: 3.45; St. Dev.: 0.28; Median:3.46
Age (years)	Mean: 30.11; St. Dev.: 2.19; Median: 30.00

Panel B: Firms ($N = 383$)	
Industry	General Coporations: 33.94%
	Finance: 29.50%
	Technology: 17.23%
	Consulting: 15.93%
	Other services: 2.09%
	Government/Non-Profit: 1.31%
On *Fortune MBA 100* list	24.28%
Publicly traded	58.49%
Annual sales ($ billions)	Mean: 22.56; St. Dev.: 43.52; Median: 6.03.
Employees (thousands)	Mean: 54.63; St. Dev.: 135.20; Median: 15.40.
Posted jobs located in the U.S.	98.10%

Table 2: OLS wage regression. Keeping the company and job characteristics fixed, salaries for full-time job offers do not depend on the ability of the person receiving the offer.

Dependent variable	$Wage_i$	$Ln(Wage)_i$
GPA_i^{MBA}	–1011.57	–0.01
	(–1.01)	(–1.04)
$Top100Undergrad_i$	332.39	0.00
	(0.73)	(0.53)
$IndustryStayer_i$	–201.90	–0.01
	(–0.38)	(–0.92)
$InternationalStudent_i$	–293.09	–0.00
	(–0.54)	(–0.40)
$Male_i$	522.53	0.01
	(1.03)	(1.02)
Age_i	–30.89	–0.00
	(–0.24)	(–0.40)
$Constant$	93878.65	11.45
	(9.28)***	(98.05)***
Class FEs	Yes	Yes
Industry FEs	Yes	Yes
Job Source FEs	Yes	Yes
Job Location FEs	Yes	Yes
Company-Job title FEs	Yes	Yes
R^2	0.48	0.40
Observations	1676	1676

Table 3: The effect of uncertainty regarding job applicants' industry fit on the firms' decision to make offers. The dependent variable across the three models estimated in the table is an indicator equal to 1 for each application that resulted in an offer. The three panels report the results of a linear probability model, a logistic regression, and a GLM model. Candidate i to job j is characterized as having low, medium or high uncertainty regarding industry fit if they have worked in the same narrowly defined industry as that of the firm offering job j, if they have worked in the same broadly (but not narrowly) defined industry as that of the firm offering job j, and, respectively, if they have not worked in the broadly defined industry to which the firm belongs. For example, candidates applying to a job j in investment banking have high uncertainty regarding industry fit if they never worked in any finance-related industry before; if they previously worked in commercial banking, for example, they would have a medium level of uncertainty regarding industry fit; whereas candidates who worked in investment banking before have a low level of uncertainty regarding industry fit for job j. The reference (thus omitted) category in all three models is $Low\ uncertainty_{ij}$. Standard errors are clustered at the job level, and are robust to heteroskedasticity.

Dependent variable	Indicator equal to 1 if candidate i's application to job j resulted in an offer		
	Linear probability model	Logistic regression Odds ratios effects	GLM model Risk ratios effects
$Medium\ uncertainty_{ij}$	–0.025	0.65	0.67
	(–4.34)***	(–4.71)***	(–4.99)***
$High\ uncertainty_{ij}$	–0.034	0.53	0.55
	(–6.96)***	(–8.32)***	(–8.83)***
GPA_i	0.05	3.18	2.95
	(9.86)***	(10.21)***	(10.95)***
$International\ student_i$	–0.03	0.54	0.56
	(–10.24)***	(–9.69)***	(–10.03)***
$Male_i$	–0.02	0.69	0.70
	(–5.63)***	(–6.30)***	(–6.78)***
$Interview\ slots_j$	0.0004	1.01	1.01
	(2.72)***	(2.96)***	(4.02)***
$Internship\ stage$	0.01	1.37	1.35
	(4.13)***	(4.04)***	(4.76)***
Class FEs	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes
R^2	0.02	0.04	0.05
Observations	30783	30783	30783

Table 4: The effect of uncertainty on hiring decisions, as a function of the recruiting stage (internship versus full-time hiring). The dependent variable is an indicator equal to 1 for each application of a candidate i to job j that resulted in an offer. The reference category is *Low uncertainty*$_{ij}$ & *Internship stage*. Standard errors are clustered at the job level, and are robust to heteroskedasticity.

Dependent variable: Indicator equal to 1 if candidate i's application to job j resulted in an offer	
	Logistic regression Odds ratios effects
Medium uncertainty$_{ij}$ & *Internship stage*	0.72
	(–3.07)***
High uncertainty$_{ij}$ & *Internship stage*	0.57
	(–6.36)***
Low uncertainty$_{ij}$ & *Full-time stage*	0.95
	(–0.36)
Medium uncertainty$_{ij}$ & *Full-time stage*	0.43
	(–5.42)***
High uncertainty$_{ij}$ & *Full-time stage*	0.41
	(–7.33)***
GPA_i	3.18
	(10.22)***
International student$_i$	0.54
	(–9.70)***
$Male_i$	0.69
	(–6.31)***
Interview slots$_j$	1.01
	(2.93)***
Class FEs	Yes
Industry FEs	Yes
R^2	0.04
Observations	30783

Table 5: The effect of uncertainty on hiring decisions, as a function of firm size, as measured by sales (Panel A) or the number of employees (Panel B). The dependent variable is an indicator equal to 1 for each application of a candidate i to job j that resulted in an offer. The reference category is $High\ uncertainty_{ij}$ & $Small\ firm_j$. Standard errors are clustered at the job level, and are robust to heteroskedasticity.

Dependent variable: Indicator equal to 1 if candidate i's application to job j resulted in an offer		
	Logistic regression: Odds ratios effects	
	Panel A: Firm size measured by sales	Panel B: Firm size measured by number of employees
$Low\ uncertainty_{ij}$ & $Small\ firm_j$	1.99	1.95
	$(5.05)^{***}$	$(5.01)^{***}$
$Medium\ uncertainty_{ij}$ & $Small\ firm_j$	1.38	1.54
	$(1.90)^{*}$	$(2.53)^{**}$
$Low\ uncertainty_{ij}$ & $Large\ firm_j$	2.50	2.43
	$(7.12)^{***}$	$(6.87)^{***}$
$Medium\ uncertainty_{ij}$ & $Large\ firm_j$	1.62	1.49
	$(4.06)^{***}$	$(3.28)^{***}$
$High\ uncertainty_{ij}$ & $Large\ firm_j$	1.35	1.27
	$(2.73)^{***}$	$(2.19)^{**}$
GPA_i	3.17	3.20
	$(10.14)^{***}$	$(10.00)^{***}$
$International\ student_i$	0.54	0.53
	$(-9.74)^{***}$	$(-9.71)^{***}$
$Male_i$	0.69	0.68
	$(-6.25)^{***}$	$(-6.27)^{***}$
$Interview\ slots_j$	1.01	1.01
	$(2.42)^{**}$	$(2.23)^{**}$
$Internship\ stage$	1.37	1.35
	$(4.09)^{***}$	$(3.90)^{***}$
Class FEs	Yes	Yes
Industry FEs	Yes	Yes
R^2	0.04	0.04
Observations	30783	30028

Table 6: The effect of uncertainty on hiring decisions, as a function of firm prestige. The dependent variable is an indicator equal to 1 for each application of a candidate i to job j that resulted in an offer. A firm is labeled as prestigious if it was included in the *Fortune MBA 100* annual rankings during 2007-2009 (Panel A), or if it receives above-median bids for interview slots from job candidates (Panel B). The reference category is $High\ uncertainty_{ij}$ & $Prestigious\ firm_j$. Standard errors are clustered at the job level, and are robust to heteroskedasticity.

Dependent variable: Indicator equal to 1 if candidate i's application to job j resulted in an offer		
	Logistic regression: Odds ratios effects	
	Panel A: Firm prestige measured by inclusion in *Fortune 100 MBA* ranking	Panel B: Firm prestige measured by number of points bid for interviews
$Low\ uncertainty_{ij}$ & $Not\ prestigious\ firm_j$	3.13	2.33
	(7.87)***	(5.74)***
$Medium\ uncertainty_{ij}$ & $Not\ prestigious\ firm_j$	1.38	1.49
	(2.38)**	(3.15)***
$High\ uncertainty_{ij}$ & $Not\ prestigious\ firm_j$	1.29	1.36
	(2.49)**	(3.55)***
$Low\ uncertainty_{ij}$ & $Prestigious\ firm_j$	1.72	1.98
	(5.80)***	(7.58)***
$Medium\ uncertainty_{ij}$ & $Prestigious\ firm_j$	1.35	1.34
	(3.49)***	(3.37)***
GPA_i	3.19	3.18
	(10.24)***	(10.21)***
$International\ student_i$	0.53	0.53
	(–9.85)***	(–9.84)***
$Male_i$	0.69	0.68
	(–6.30)***	(–6.43)***
$Interview\ slots_j$	1.01	1.01
	(2.85)***	(2.38)**
$Ln(Firm\ sales_j)$	1.09	1.06
	(3.22)***	(2.84)***
$Internship\ stage$	1.39	1.37
	(4.30)***	(4.10)***
Class FEs	Yes	Yes
Industry FEs	Yes	Yes
R^2	0.05	0.05
Observations	30783	30783

Table 7: Changes in the quality of the applicant pool. Participants in the on-campus recruiting process for full-time jobs have lower general ability and are more likely to be industry switchers (based on the narrowly defined 60-industry classification scheme used in our recruiting setting) relative to individuals who are done seeking employment after the internship stage.

	GPA	% who were switchers at internship stage
Participated in full-time recruiting on campus	3.44 (N=1100)	85%
Did not participate in full-time recruiting on campus	3.50 (N=307)	80%
Difference	-0.06***	5%**

Table 8: The effect of uncertainty on hiring decisions, as a function of the candidate's general ability measured by their GPA while in business school. The dependent variable is an indicator equal to 1 for each application of a candidate i to job j that resulted in an offer. $High\ GPA_i$ and $Low\ GPA_i$ are indicators for whether candidate i' GPA is above or below median. Standard errors are clustered at the job level, and are robust to heteroskedasticity.

Dependent variable: Indicator equal to 1 if candidate i's application to job j resulted in an offer		
	Logistic regression: Odds ratios effects	
	Panel A	Panel B
$Low\ uncertainty_{ij}$ & $High\ GPA_i$		1.63
		(3.60)***
$Medium\ uncertainty_{ij}$ & $High\ GPA_i$	0.62	1.01
	(–4.09)***	(0.08)
$High\ uncertainty_{ij}$ & $High\ GPA_i$	0.50	0.82
	(–7.07)***	(–1.64)
$Low\ uncertainty_{ij}$ & $Low\ GPA_i$	0.61	
	(–3.60)***	
$Medium\ uncertainty_{ij}$ & $Low\ GPA_i$	0.41	0.67
	(–7.05)***	(–3.02)***
$High\ uncertainty_{ij}$ & $Low\ GPA_i$	0.33	0.54
	(–10.96)***	(–5.10)***
$International\ student_i$	0.50	0.50
	(–10.84)***	(–10.84)***
$Male_i$	0.73	0.73
	(–5.46)***	(–5.46)***
$Interview\ slots_j$	1.01	1.01
	(2.58)***	(2.58)***
$Ln(Firm\ sales_j)$	1.09	1.09
	(3.20)***	(3.20)***
$Prestigious\ firm_j$	0.78	0.78
	(–2.66)***	(–2.66)***
$Internship\ stage$	1.43	1.43
	(4.60)***	(4.60)***
Class FEs	Yes	Yes
Industry FEs	Yes	Yes
R^2	0.04	0.04
Observations	30783	30783