

Human Capital and Career Success: Evidence from Linked Employer-Employee Data

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Abstract

Individuals acquire general human capital through formal schooling. However, human capital acquisition does not stop upon graduation. Workers continue to accumulate human capital on the job. Such on-the-job training can be rather narrow in its scope and workers remain mostly within the same field. It is, however, also possible that workers experience diverse fields and become “generalists.” By using Denmark’s registry data, we provide fresh evidence on the role of such different types of human capital in worker’s career success, defined as appointments to top executive positions. The Danish registry data provide accurate and complete career histories (most importantly annual longitudinal data on which firm each worker works for and what role she plays in the firm) along with detailed personal characteristics for the population of Danish workers. As such, unlike prior studies, we are able to define the contestant pool flexibly and realistically, taking into consideration not only internal but also external candidates. We find that: (i) broadening the scope of human capital by experiencing diverse roles is indeed advantageous for career success; (ii) initial human capital earned through formal schooling and subsequent human capital obtained informally on the job are complements in the production of career success; and (iii) it is more beneficial to broaden the scope of human capital within the firm than without, pointing to the significance of firm-specific human capital for career success.

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I. Introduction

Individuals acquire general human capital through formal schooling. However, human capital acquisition does not stop upon graduation. Workers acquire both general and firm-specific human capital through learning by doing, or on-the-job training. On-the-job training can be rather narrow in its scope and workers remain mostly within the same field. It is, however, also possible that workers may go through rather extensive on-the-job training, experience diverse fields, and become a “generalist.” This paper provides fresh evidence on the role of the different types of human capital in workers’ career success, defined as appointments to top executive positions.

In so doing, we make three notable contributions to the literature. First, Lazear (2005) develops a theory of entrepreneurship and uses unique data on career histories of Stanford MBA graduates to provide evidence that entrepreneurs are more likely to be generalists with diverse job experiences. More recently, using the same Stanford MBA graduate data, Lazear (2010) extends the analysis to corporate leaders and finds similar evidence that corporate leaders are also more likely to be generalists. In this paper, we expand his analysis to the population of workers in Denmark by taking advantage of Denmark’s registry data covering the population of Danish workers from 1992 to 2002. The importance of generalist career development for corporate leaders, which Lazear (2010) found for a relatively small and selective sample of Stanford MBAs, is also uncovered for the population of workers in Denmark.

Second, Gibbons & Waldman (2006) extend their earlier theory of wage and promotion within the firm (Gibbons & Waldman, 1999) and predict complementary interplay between initial human capital attained through formal schooling and subsequent human capital acquired

on the job. We take advantage of large variations in formal schooling among the population of workers in Denmark and provide the first rigorous evidence on such a complementary relationship between formal schooling and on-the-job training.

Last but not least, since each individual worker is matched to the employer each year in the Danish registry data, we are able to identify clearly which part of each worker's career history remains within the present firm and which part is outside the present firm. Hence we can estimate the relative value of human capital acquired within the firm to human capital acquired outside of the firm. While there is a large body of the literature on the relationship between firm-specific human capital and wages, the relative value of firm-specific human capital in the context of career success has rarely been studied. Our paper provides novel evidence on the relative benefit of firm-specific human capital for career success, thereby informing a long debate over the relative value of firm-specific human capital to general human capital.¹

In the next section, we describe the empirical strategy and data in detail. Section III presents our key results, followed by concluding remarks in Section IV.

II. Empirical Strategy and Data

To obtain rigorous and systematic evidence on interplay between human capital (formal and informal) and career success, we will need detailed and reliable data on each individual worker's schooling (formal human capital formation) and complete career history (human capital acquisition through informal on-the-job training). Furthermore, we define career success as

¹The literature on the role of specific and general human capital in wage determination is vast. See Farber (1999) for a review of the earlier literature. More recent efforts in the field are often aimed at unpacking the concept of specific human capital by introducing a skill-weights approach or a task-weights approach (see, for instance, Lazear, 2009, and Gathmann & Schonberg, 2010). Our paper makes a new and complementary contribution to this literature in two important ways. First, we focus on an alternative discrete career success outcome (a top executive appointment) rather than a continuous career success outcome or wage growth. Second and perhaps more importantly, by contrasting the benefit of experiencing a certain role within the firm to the benefit of experiencing the same role elsewhere for career success, we assess the relative value of firm-specific human capital to general human capital in a simple and intuitive way.

appointments to top executive positions, and top executives are either promoted internally or recruited externally. It follows that the data will need to include both internal and external candidates for top executive positions. In other words, ideally the data are comprehensive enough to include any individual who has a reasonable chance of being appointed to a top executive position.

Such data are rare, and the register-based Integrated Database for Labour Market Research (IDA) created by Statistics Denmark is unusually suited for the objective of this paper. First, the IDA database contains detailed information on *all* employers and *all* employees in the Danish economy. Using unique firm and individual identifiers, we construct Linked Employer-Employee Data, which provide detailed information on all employment matches in the private sector of the Danish Economy since 1980.² As such, we have data for the population of workers in the private sector in Denmark, which allows us to construct the pool of contestants for top executive appointments, and check the robustness of the results to the use of alternative constructs of the contestant pool.

Second and perhaps more importantly, the data contains detailed information on formal schooling and allows for the construction of our key variable – the breadth of informal human capital. The theory developed by Lazear (2005, 2010) predicts that it is the number of different roles an employee has experienced in the labor market which increases the probability of career success. Fortunately the IDA provides complete and reliable data on the number of different occupations that each individual worker has experienced throughout his/her past employment histories. Based on this information, we set our key variable, “ROLES,” equal to the number of different occupations each worker has experienced in the past, counting the same occupation

² We focus on private-sector employees, for public-sector employment tends to be subject to a different set of regulatory framework and labor market conditions, in particular more non-economic influences such as political considerations (Pedersen et al., 1990).

experienced at two different employers as two different roles.³

Since IDA's occupational data play a crucial role in our analysis, we will in the following provide some necessary detail on the nature, scope and reliability of IDA's occupational data. The "Bekendtgørelse af lov om Danmarks Statistik" (Ministerial Order on the Statistics Denmark Act) requires every employer in Denmark to annually report an occupational classification code for each of its full-time employees, following the DISCO. The DISCO is the Danish version of the ILO's ISCO (International Standard Classification of Occupations), and it follows all the requirements set forth by the ILO. Normally the DISCO code reporting to Statistics Denmark takes place directly through the company's electronic salary systems.

Since there was a major change in the DISCO in 2003 (a switch from a four-digit classification system to a more detailed six-digit classification system) and the starting year of our occupation data is 1992, we choose 1992–2002 for the time period under study. However, when it comes to data on firm tenure and general work experience, we will use data prior to 1992. That is, we further match our Linked Employer Employee Data with pension contribution data dating back to 1964 to add data on firm tenure and general work experience.

Even prior to the 2003 revision of the DISCO, however, the DISCO codes had been updated regularly, with some codes being eliminated and some new codes being created. Of obvious concern is therefore the possibility of spurious changes in the DISCO codes assigned to workers who experience no real change in their roles (occupations). To demonstrate the spurious changes in the DISCO code, consider an employee to whom a DISCO code X is assigned in 2000. Say that, in 2001, DISCO code X is eliminated. The employer is now required to assign a new code to this individual in spite of the fact that the employee is fulfilling exactly the same role as in 2000. The creation of new codes may also produce similar spurious changes in the

³ We also tried an alternative definition of ROLES in which we simply count the number of different occupations (experiencing the same occupation at two different firms counted as one role) and found no discernible difference in our key results.

DISCO codes. We believe, however, that our analysis is largely free from such spurious changes in the DISCO codes, as we base our main analysis on one-digit or two-digit classifications. As shown in Table 1, over the 1992–2002 period, reassuringly at the one-digit and two-digit levels, there was only one new code added. Furthermore, as shown in the lower panel of the table, the newly added code turned out to be a rather insignificant one with fewer than 1,000 employees assigned to this code each year.

The table also shows, as expected, that more code changes occurred at the three-digit and four-digit levels, although such changes often involved a relatively small number of employees. In sum, by focusing on the one-digit and two-digit levels the issue of spurious code changes is minimized, and for this reason the results presented in this paper will make use of occupations at the two-digit level.

Our operational definition of career success is an appointment to a top executive position in a firm with 100 or more employees.⁴ Top executive positions are defined as DISCO 12 Corporate Managers and DISCO 13 General Managers.⁵ In 2002, there were 601,467 individuals with proper DISCO codes who worked for firms with 100 or more employees in Denmark. Of these 601,467 individuals, 16,168 individuals were in DISCO 12 and 2,179 individuals were in DISCO 13, together amounting to a little over 3 percent of all workers in firms with 100 or more employees. Furthermore, those individuals who are appointed to top executive positions are estimated to earn 27 percent more upon the appointment than other employees, controlling for age, gender, tenure, general work experience, education, and year effects. Furthermore, on

⁴ Our results are robust to the use of different cut-off levels of employment, such as 50 employees. These as well as all other unreported results are available upon request from the corresponding author (tkato@colgate.edu).

⁵ Smith, Smith, & Verner (2010), in their recent study of gender pay gaps in top management positions in Denmark, use a similar method to define top management positions of the top 2000 private firms in Denmark.

average top executives earn 83 percent more than the average employee.⁶ Thus, regarding appointments to these top executive positions as career success appears to be appropriate.⁷

To uncover what factors contribute to career success, we first use our unusually comprehensive database to construct a contestant pool, i.e., identify individuals who had some reasonable chance of becoming a top executive. The results presented below focus on a contestant pool that is constructed as follows:

1. For each individual who was appointed to a top executive position in year t , we identify his/her occupation (2-digit DISCO code) in year $t - 1$.
2. We consider anyone who listed one of these occupations as their primary occupation in year $t - 1$ as part of the contestant pool for a top executive position in year t .

This is probably the broadest and least restrictive construct of the contestant pool for top executive appointments. Figure 1 shows the number of top executive appointments and the size of the contestant pool by occupations (one-digit DISCO codes). As shown in the figure, top executives are appointed from a very broad set of occupations including clerks and machine operators, which is consistent with high social mobility in Denmark (Aaberge et. al., 2002). We also consider alternative narrower definitions of the contestant pool and find that our key results are insensitive to the use of those alternative definitions.⁸

To study the benefit of having a broader scope of human capital (or breadth of human capital) obtained through various occupational experiences for career success, naturally we have

⁶ For a detailed discussion of the economic returns to within- and cross-firm mobility in Denmark, see Frederiksen, Halliday, & Koch (2010).

⁷ An alternative and narrower definition of career success is an appointment to CEO. Unfortunately, this requires the use of the four-digit codes, and, more importantly, we discovered that not all firms assigned the same four-digit code to their CEOs.

⁸ Instead of using only two-digit DISCO codes, we tried three- and four-digit codes and found that the coefficient on ROLES (our key measure of the breadth of informal human capital used extensively below) remained positive and significant. In addition, in the subsequent section, we report our additional logit estimations of career success defined as appointments to specific functional area directorships in which the contestant pool for each functional area directorship is defined more narrowly as those competing for the specific functional area directorship.

to limit our analysis to those employees for which reasonably long and continuous career history data are available. In spite of the relative completeness of the Danish registry data, there are several reasons why some individuals lack complete occupational histories. First, the “Bekendtgørelse af lov om Danmarks Statistik” (Ministerial Order on the Statistics Denmark Act) does not require reporting of DISCO codes for those individuals who are out of the labor force, unemployed, self-employed, working in the workplace with fewer than 10 employees, or working in a firm directly engaged in agriculture, fishery, or forestry. As such, any Danish resident worker who falls into any one of those categories as a primary labor market status for a particular year will have a missing DISCO code for that particular year. Second, young employees or recently immigrated individuals will not have sufficiently long occupational histories. Finally, any Danish citizen who works outside of Denmark for over six months and thereby is no longer liable to Danish income tax for that year is also exempt from the annual reporting requirement.

For the rest of the paper, we report the results based on all workers with at least eight years of complete employment histories. However, we also repeated the analysis based on a less restrictive exclusion criterion (all workers with at least five years of complete occupational histories) and reassuringly found no discernible difference.

In short, we identify all employees working in the private sector in Denmark in year t who have complete occupational histories between year $t - 8$ through year $t - 1$. We then consider each employee’s probability of being appointed to a top executive position between year t and $t + 1$, given her current occupation (occupation in year t), her breadth of informal human capital (a measure constructed from the information on the employee’s career history between $t - 8$ and $t - 1$), the level of formal schooling, and controls. Ultimately we end up estimating a logit model with the annual probability of top executive appointment in 2000 and 2001 as the dependent

variable and the measures of formal and informal human capital as our key independent variables.

In Table 2 we present descriptive statistics for individuals with complete eight-year employment histories as well as for all individuals (including those who lack complete eight-year employment histories in the private labor market). First, educational attainments appear to be quite similar between individuals with eight years of complete employment histories and all individuals. Second, as expected, individuals with complete eight-year employment histories have considerably longer tenure and labor market experience than all individuals, and individuals with complete employment histories are older and more likely to be male than all individuals.

Table 2 further divides individuals with complete employment histories into two groups: those who left the contestant pool and became top executives (those with career success) and those who remained in the contestant pool (those without career success). When comparing these two groups our main focus is on differences in the levels of formal schooling and the breadth of human capital acquired informally on the job. For formal schooling, individuals are divided into five groups: Less than High School; Vocational Training; High School; College; and Graduate.⁹ As explained above, the breadth of informal human capital is measured by the number of different roles (different occupations in the context of our analysis) that each worker has experienced over the past eight years (ROLES).

Table 2 shows that only 11 percent of those without career success have a college or graduate degree. In contrast, 36 percent of those with career success have at least a college degree. In addition, individuals with career success have experienced considerably more different roles in the past than those in the contestant pool without career success. For example, nearly one in two individuals with top executive appointments had at least three different roles in the past,

⁹ University education in Denmark consists of a three-year bachelor program (college) followed by a two-year master's program. PhD programs are available after a master's degree is obtained. We combine master's and PhDs and denote them as graduates.

whereas less than 30 percent of those in the contestant pool without such appointments have had three different roles. Further, the proportion of individuals with five or more different roles is higher among those with career success than among those without career success (10 percent vs. 5 percent). These preliminary findings suggest that formal education may play a significant role in career success and that the breadth of human capital acquired through informal OJT may be also important. In the next section we will estimate logit models to confirm these preliminary findings with rigor.

III. Econometric Specifications and Results

To provide rigorous and systematic evidence on interplay between human capital (formal and informal) and career success, we begin by estimating the following baseline logit model of top executive appointments:

$$(1) \quad \Pr(\text{APPOINTMENT}_{it}=1) = \Lambda(\alpha + \beta\text{ROLES}_{it} + \gamma\text{SCH}_{it} + \delta\text{FEMALE}_i + \rho\mathbf{Z}_{it})$$

where APPOINTMENT_{it} is equal to one if worker i is appointed to a top executive position in a large firm (with 100 or more employees) between year t and $t+1$, zero otherwise; ROLES_{it} is the measure of the breath of informal human capital (described in detail above) for worker i ; SCH_{it} is a column vector of dummy variables capturing the level of formal educational attainments of worker i at the end of year t ; FEMALE_i is a dummy variable taking a value of one if worker i is female, zero otherwise; \mathbf{Z}_{it} is a column vector of other control variables for worker i (a quadratic in age, tenure, and general work experience and a vector of 34 (two-digit) occupation dummy variables to indicate his/her occupation in year t). In addition, since we are pooling two years of data ($t=2000$ and 2001), we include the 2001 year dummy variable (which takes a value of one if $t=2001$, zero otherwise) to control for year effects.¹⁰ α , β , and δ as well as the two vectors γ and

¹⁰ We also estimated Eq. (1) for 2000 and 2001 separately without pooling them. Reassuringly, for

ρ are the parameters to be estimated. Hereafter subscripts i and t will be omitted for brevity of exposition.

The sign and significance of the estimated coefficient on ROLES can be used to test one of our key hypotheses -- the probability of being assigned to a top executive position will increase with the breadth of informal human capital. Such a “Jack of all trades” effect is formally discussed in the context of the successful formation of entrepreneurship by Lazear (2005) and later extended to the case of successful corporate leadership by Lazear (2010). In the context of our data, since top executives are required to make decisions on a wide variety of issues, an individual with a broader set of labor market experiences is more valuable and hence is more likely to be appointed to a top executive position, other things being equal. A similar and equally plausible story is provided by Gibbons and Waldman (2004). An individual with a broader scope of experiences can be considered to possess a greater quantity of task-specific human capital and hence enjoy a higher likelihood of being appointed to a top executive position.¹¹

For SCH, our data allows us to identify five different levels of formal educational attainments, and we code the data as follows: HIGH SCHOOL=1 if worker i 's highest educational attainment is a regular high-school diploma, zero otherwise; VOCATIONAL=1 if

each year we obtained similar results to what we report in the paper for the pooled data.

¹¹ It is possible that individuals with high innate ability/aptitude are more likely to experience more roles, and that such individuals are more likely to be appointed to top executive positions. To the extent to which our set of control variables do not fully account for such innate ability/aptitude, the estimated effect of ROLES may be capturing not only the effect on top executive appointments of ROLES but also the effect on top executive appointments of such innate ability/aptitude. Unfortunately our ability to account for such ability bias is limited. First, our data do not include any direct measures of innate ability/aptitude. Second, since top executive appointments as defined in our analysis do not occur multiple times for the same individuals, we cannot include individual fixed effects in Eq. (1) to control for time-invariant unobserved innate ability/aptitude. There is, however, an indirect way to discern the severity of the ability bias. Since the IDA provides panel data on wages over 1992–2002, we can estimate a Mincerian wage equation with individual fixed effects. The estimated individual fixed effects are supposed to capture unobserved innate ability/aptitude of individual workers. If such individual fixed effects are highly correlated with our measure of the breadth of informal human capital (ROLES), the aforementioned ability bias can be quite serious, and our capability to interpret the estimated coefficients on ROLES as a clear indication of the importance of the breadth of informal human capital for career success will be rather limited. Fortunately, it turned out that the correlation coefficient between the estimated individual fixed effects and ROLES is only 0.077, suggesting that the aforementioned ability bias may not be too serious.

worker *i*'s highest educational attainment is a vocational high-school diploma, zero otherwise; COLLEGE=1 if worker *i*'s highest educational attainment is a college degree, zero otherwise; and GRADUATE=1 if worker *i*'s highest educational attainment is a graduate degree, zero otherwise (omitted reference group is LESS-THAN-HIGHSCHOOL=1 if worker *i*'s highest educational attainment is less than a high school diploma).

We hypothesize that an individual with greater schooling possesses a greater amount of general human capital and hence enjoys higher odds of obtaining a top executive appointment, according to the human capital theory. Alternatively, the signaling theory also predicts a higher chance of being appointed to a top executive position for an individual with a higher level of formal schooling since the level of schooling may be correlated with her unobserved innate ability.

The coefficient on the FEMALE dummy will be informative about the presence of a “glass ceiling” for females (see, for instance, Albrecht, Björklund, & Vroman, 2003; Blau & DeVaro, 2007; and Smith et al., 2010). Further, the gender dummy combined with education will shed light on the “invisibility” hypothesis (Milgrom & Oster, 1987; DeVaro, Ghosh, & Zoghi, 2007). The idea is that formal schooling may serve as a relatively more important signaling device for women who tend to lack an effective informal signaling device such as an “old boy network”.

Column (i) of Table 3 shows the logit estimates of Eq. (1). The estimated coefficient on ROLES is positive and statistically significant at the 1 percent level, showing that the probability of being appointed to a top executive position rises significantly with the number of roles experienced in the past, after controlling for formal educational attainments, gender, age, current occupation, tenure, and general work experience.¹² As such, the data supports the hypothesis that

¹² Because some individuals enter the sample in both 2000 and 2001, we cluster standard errors at the individual level in all regressions presented below.

a broader scope of human capital obtained informally on the job improves the odds of career success. The economic significance of the estimated coefficient on ROLES as well as on schooling variables will be discussed later in the section.

To see if the results change when we use a more general and less parsimonious specification which allows for possible nonlinear relationships between the breadth of human capital and career success, we replace ROLES with a set of dummy variable – ROLES1=1 if worker i has experienced one role which is different from the current one, zero otherwise; ROLES2=1 if an individual experienced two roles which are different from the current one; likewise for ROLES3 to ROLES8. Reassuringly, as shown in column (ii) of Table 3, the estimated coefficients on the dummy variables are positive and statistically significant at the 1 percent level, and the size of the estimated coefficients rises with the level of the dummy variables. Overall, the observed significant positive effect on career success of the breadth of human capital is not sensitive to whether we use a parsimonious linear specification (ROLES) or a more general nonlinear specification (a set of dummy variables).

We interpret the positive and significant coefficients on ROLES as an indication of the importance of the breadth of human capital obtained informally on the job for career success. This interpretation is based on our assumption that a worker in the contestant pool increases his/her breadth of informal human capital mostly through a series of lateral moves rather than a series of vertical moves (or promotions). If this assumption is wrong, a worker who has experienced a greater number of roles prior to a top executive appointment may well be the one who has experienced a greater number of promotions or has been climbing up the promotion ladder rapidly. In other words, there can be an alternative interpretation of the positive and significant coefficients on ROLES – those who experience a series of promotions with discrete wage increases prior to top executive appointments are more likely to win top executive

appointments.

To explore the relative validity of the alternative interpretation, we use the same 2000 and 2001 IDA data and estimate a cross-sectional Mincerian wage equation, augmented by a set of eight dummy variables that are designed to capture the wage effect of the breadth of human capital obtained informally on the job, or ROLES1, ROLES2, ROLES3, ..., ROLES8. If the alternative interpretation is valid, we should observe that those with a great number of roles experienced earn substantially more than those with less breadth of human capital obtained informally on the job, for those with such great breadth of informal human capital are also those with a great number of promotions which accompany discrete pay raises.

We find no evidence for a linear relationship between wage and the breadth of informal human capital. Instead the results suggest an inverse U-shape relationship – the worker's wage rises as the number of different roles that he/she has experienced in the past (ROLES) increases, yet his/her wage reaches its maximum value at ROLES=6 and starts to fall rather rapidly as ROLES increases beyond 6. Perhaps more importantly, the magnitude of the wage effect of the breadth of informal human capital is small. Thus, even at the peak of the wage-ROLES profile (ROLES=6), the size of such a maximum wage effect is found to be only 2 percent. In other words, those in the contestant pool who have experienced six different roles earn only 2 percent more than those in the same contestant pool who have never experienced a different role.

In short, Danish workers increase their breadth of human capital without experiencing much wage growth. If there is any wage increase associated with increased roles, the relationship between such a wage increase and the breadth of informal human capital is non-linear, and wage actually starts to **fall** once the number of experienced roles rises beyond six. It is probably safe to assume that most of role increases (human capital broadening) in the Danish workplace occur in the form of lateral moves rather than in the form of promotions with discrete wage increases.

The estimated coefficients on the formal schooling variables are found to be positive and statistically significant at the 1 percent level, suggesting that individuals who have high-school diplomas or better enjoy higher odds of winning top executive appointments than individuals whose educational attainment is less than high school. Moreover, a glance at the relative size of the estimated coefficient on each educational dummy variable suggests that the winning odds of top executive appointments appear to rise with the level of formal schooling. The results are consistent with either the human capital theory emphasizing formal schooling as production of general human capital or the signaling theory stressing formal schooling as a credible labor market signal (see Rubinstein & Weiss, 2007, for a recent survey of the literature on human capital and signaling).¹³

The estimated coefficient on FEMALE is negative and statistically significant at the 1 percent level. Thus, after controlling for education, age, current occupation, tenure, and general work experience as well as ROLES, women are less likely to be appointed to top executive positions, which is consistent with the glass-ceiling hypothesis.

To further explore gender differences in the relationships between career success and human capital, we estimate Eq. (1) for men and women separately. The results are presented in column (i) of Table 4. First, the breadth of human capital obtained informally on the job is important for both men and women as it increases the likelihood of being appointed to a top executive position. Second, women benefit relatively more from formal schooling than men. That is, using modal values for all dummy variables and mean values for all continuous variables we calculate the predicted probability of winning a top executive appointment for the typical female and male contestant, given different levels of educational attainment. To demonstrate the

¹³ DeVaro & Waldman (2012) report that promotions work differently for workers with master's degrees than those with PhDs. We repeated the same logit analysis, dividing those with graduate degrees into the two groups. However, due to the small number of individuals with Ph.D degrees in Denmark, we find no statistically significant differences between those two groups of individuals with graduate degrees.

relative magnitude of gender gaps in top executive appointments for different levels of educational attainment, for each educational attainment level we divide the predicted odds of winning a top executive appointment for the typical female worker by the predicted odds of winning a top executive appointment for the typical male worker. The resulting female/male ratios in the top executive appointment rates are depicted in Figure 2. The figure demonstrates that in the competition for top executive positions, women with graduate education are less disadvantaged over their male counterparts than women with lower levels of education. This result is in line with the invisibility hypothesis.

Formal schooling and informal OJT: Complements or substitutes?

As discussed earlier, Gibbons & Waldman (2006)'s extended theory of wage and promotion within the firm predicts complementarity between human capital attained by formal schooling and human capital acquired on the job. We take advantage of variations in formal schooling among the population of workers in Denmark and examine whether formal schooling and on-the-job training are indeed complements in the production of career success. Specifically, we estimate Eq. (1) augmented by a set of interaction terms involving ROLES and educational dummy variables.

Column (iii) of Table 3 summarizes the logit estimates of the augmented version of Eq. (1). The estimated coefficients on the interaction terms involving ROLES and formal schooling variables are insignificant at lower levels of schooling yet positive and significant at the 5 percent level for individuals with graduate training. The observed complementarity between formal schooling and informal OJT is consistent with Gibbons & Waldman's (2006) key insight that formal schooling enhances each individual's general learning ability and hence makes informal OJT more effective.

To demonstrate the importance of formal schooling and informal OJT, again we use modal values for all dummy variables and mean values for all continuous variables in the above augmented model with interaction terms and calculate the probability of top executive appointments for the typical worker with different values for ROLES and for each formal schooling category (Less than High School; High School; Vocational; College; and Graduate). The resulting role-career success profiles are drawn in Figure 3.

The typical college graduate with minimal breadth of human capital (ROLES=0) is predicted to have a little over a 1 percent chance of winning a top executive appointment in a large firm in Denmark, and is about twice as likely to be appointed to a top executive position as the comparable high school graduate. As the breadth of human capital earned through informal OJT increases, both the typical college graduate and the typical high school graduate will enjoy higher odds of career success. For example, the typical high school graduate with considerable breadth of informal human capital, say ROLES=4, is twice as likely to be appointed to a top executive position as the typical high school graduate with ROLES=0 (minimal breadth of informal human capital). Note that the typical high-school graduate's odds of being appointed to a top executive position are now comparable to the probability of a typical college graduate with minimum breadth of human capital obtained informally on the job. In other words, the typical high school graduate needs to experience four additional roles to overcome the initial disadvantage of not having a college degree.

Perhaps more importantly, the difference in the top executive appointment probabilities between graduate degree holders and college graduates is rather small when the breadth of informal human capital is narrow. However, the gap widens considerably as the breadth of informal human capital increases due to the significant complementarity between formal schooling and informal OJT for graduate degree holders. For example, the typical college

graduate with ROLES=4 is about *twice* as likely to be appointed to a top executive position as the typical college graduate with ROLES=0, while the typical graduate degree holder with ROLES=4 is about *three times* more likely to be appointed to a top executive position as the typical graduate degree holder with ROLES=0. This demonstrates the importance of complementarity between formal schooling and informal OJT in the context of career success.

We repeat the same analysis for men and women separately, and the results are presented in column (iii) of Table 4. The estimated coefficients on an interaction term involving ROLES and GRADUATE are positive and significant at the 5 percent level for men, yet not at all significant for women, suggesting that complementarity between graduate degrees and informal OJT applies to men only. In fact, there is some evidence suggesting that for women formal schooling and informal OJT may be substitutes. However, overall for women the coefficients are not precisely estimated and the results are far from definitive.

Firm-specific human capital

As discussed earlier, roles experienced outside the worker's present firm may not be a perfect substitute for roles experienced within the worker's present firm, for there may be firm-specific human capital formed through internal work experiences. To examine the degree of substitutability between internally acquired experiences and externally obtained experiences, we introduce a new variable: INT_ROLES, which equals the total number of roles the employee has experienced internally (not counting the current role).

We estimate Eq. (1) augmented by INT_ROLES. The estimated coefficients on ROLES and INT_ROLES are reported in column (ii) of Table 5 (the estimated coefficient on ROLES in the baseline logit regression is also shown in column (i) for convenience). The estimated coefficient on INT_ROLES is positive and statistically significant at the 1 percent level. Thus,

holding constant formal educational attainments, gender, age, current occupation, tenure, and general work experience as well as the total number of ROLES, having experienced more roles internally results in a significantly higher probability of career success. Note since we are holding the total number of roles constant, the estimated coefficient on INT_ROLES reflects the value of experiencing a role internally as opposed to externally, and thereby shows the importance of firm-specific human capital acquired informally on the job.

As done for formal schooling and informal OJT in Figure 3, we demonstrate the magnitude of the effect of internal and external experiences on career success in Figure 4. Using the estimated coefficients of Model (ii) in Table 5, we produced role-career success profiles for two types of college graduates: (a) internal career developers (ROLES=INT_ROLES=0, 1, 2, 3, 4, 5, and 6); and (b) external career developers (ROLES=0, 1, 2, 3, 4, 5, and 6, and INT_ROLES=0). In both cases, as the typical college graduate expands the breadth of informal human capital, the probability of being appointed to a top executive position rises. However, the magnitude of the benefit of the breadth of informal human capital differs considerably between the two cases (internal and external career development). For the case of internal career development the appointment probability for the typical college graduate rises from 0.5 percent to over 2 percent as the scope of informal human capital broadens from 0 to 4. For the case of external career development the same amount of informal human capital broadening results in an increase in the probability from 0.5 percent to a little less than 1 percent. Considering that tenure and age are fully controlled for, the advantage of expanding the scope of informal human capital within the firm as opposed to outside the firm appears to be considerable, pointing to the importance of firm-specific human capital.

To shed further light on the distinction between internal vs. external career development, we now expand specification (ii) in Table 5 to a multinomial logit framework with three

destinations: (i) being appointed to a top executive position internally (promotion); (ii) being appointed to a top executive position externally (external recruitment); and (iii) not being appointed to a top executive position. The results are presented in Table 6. The estimated coefficients on ROLES are positive and statistically significant at the 1 percent level for both internal promotion and external recruitment, confirming the importance of the breadth of human capital for career success.

It is also not too surprising that the estimated coefficient on INT_ROLES is found to be positive and statistically significant at the 1 percent level for internal promotion. Holding constant formal educational attainments, gender, age, current occupation, tenure, and general work experience as well as the total number of experienced roles, having broader internal breadth of human capital will result in a significantly higher probability of internal promotion to a top executive position. Interestingly the estimated coefficient on INT_ROLES for external recruitment is also found to be positive and statistically significant at the 10 percent level. Expanding the scope of human capital through on-the-job training in the present firm thus helps an individual attain a top executive appointment not only in the present firm through internal promotion but also in a different firm through external recruitment.

To demonstrate the economic significance of firm-specific human capital in the multinomial logit framework, with internal promotion and external recruitment as two distinct means to be appointed to a top executive position, we produce Figure 5. The figure considers the case of internal career development with all occupational experiences, including the current one in the same firm (ROLES=INT_ROLES), and plots role-career success profiles, distinguishing top executive appointments through internal promotion from top executive appointments through external recruitment. First, the steepness of the role-career success profile for internal promotion demonstrates vividly the considerable benefit of extending the breadth of human capital

internally for winning a top executive appointment through internal promotion. In contrast, the relative flatness of the role-career success profile for external recruitment shows that such internal human capital formation is of less value when it comes to external appointments. It is important, however, to note that the profile is still positively-sloped and that expanding the breadth of human capital internally still helps the typical college graduate to obtain a top executive appointment through external recruitment.

Finally, studies using wage regressions to gauge return of human capital tend to point to the importance of industry-specific human capital as opposed to firm-specific human capital (see, for example, Neal, 1995). To see if our finding of the significant positive role that firm-specificity plays in top executive appointments remains valid when we introduce industry-specificity, we include an additional variable to control for industry-specificity. That is, we create a new variable measuring the number of different industries in which an individual has worked in the past and augment Eq. (1) with this new variable which captures the worker's breadth of industry experiences. Reassuringly, we find that the estimated coefficient on this new variable is insignificant and that the rest of the estimated coefficients change little. As such, our results are robust to controlling of industry-specificity.

Breadth of informal human capital and functional areas

It is plausible that the value of the breadth of informal human capital differs among functional areas. To identify possible differences we repeat the above analysis separately for four key functional areas: Finance, HR, R&D, and Sales/Marketing. We define top executive appointments in Finance as changes from DISCO Major Groups 2 through 9 and all codes in firms with fewer than 100 employees to DISCO 1231 FINANCE AND ADMINISTRATION DEPARTMENT MANAGERS in large firms with 100 or more employees. Likewise, top

executive appointments in HR, Sale/Marketing, and R&D are defined as transitions into DISCO 1232 PERSONNEL AND INDUSTRIAL RELATIONS DEPARTMENT MANAGERS, DISCO 1233 SALES AND MARKETING DEPARTMENT MANAGERS, and DISCO 1237 RESEARCH AND DEVELOPMENT DEPARTMENT MANAGERS, respectively. Note that we do rely on the four-digit codes to identify appointments to the various directorships in this last exercise. However, after a careful review of those four specific codes (1231, 1232, 1233, and 1237), we are confident that insofar as those four codes are concerned, they are stable over time and there is no inconsistency.

Table 7 presents the results. The estimated coefficients on ROLES are positive and significant at the 1 percent level in all four cases, emphasizing the importance of the breadth of human capital for appointments to directorship in each of the functional areas. Figure 6, which is produced from the estimated coefficients of specification (i) in a similar fashion to earlier figures, demonstrates that broadening the scope of informal human capital is particularly helpful for career success in R&D as compared to other functional areas.¹⁴

To further investigate the relative importance of firm-specific human capital in each functional area, we distinguished internal roles from external roles as in the previous subsection. The results are shown in specification (ii). Firm-specific experience appears to be generally beneficial for career success and in R&D in particular.

Why is the breadth of human capital especially beneficial for career success in R&D? First, we hypothesize that the R&D department director's ability to effectively engage in cross-functional knowledge sharing and coordination is particularly important for corporate competitiveness. For instance, an R&D director with marketing experience is more likely to know when and how the R&D department should share information on its new product and process

¹⁴ Due to the large difference in the level of predicted probabilities of directorship appointments among functional areas, we normalized each predicted probability by dividing it by the predicted probability for an individual with ROLES=0 for each functional area.

with the marketing department director. She is also more apt to know what sort of information and in what timeline the marketing department will need to get such information in order to develop a winning marketing strategy. In addition, the R&D department director with an internal marketing experience tends to know key personnel in the marketing department personally, and therefore information sharing and coordination between the R&D department and the marketing department are more likely to proceed smoothly.¹⁵ In contrast, inter-departmental knowledge sharing and coordination by other functional area directors are also useful yet may be less vital for corporate competitiveness than those by the R&D department director.

IV. Concluding Remarks

Denmark's registry data provide accurate and complete career history data along with detailed personal characteristics (e.g., education, gender, work experience, tenure, and others) for the population of Danish workers. That our data include all workers in Denmark as opposed to a small subset of the labor force has given us unusual flexibility in terms of the construction of the contestant pool for top executive appointments. Our preferred construct is the least restrictive one, i.e., a group of all individuals in Denmark who during last year worked in the same occupations as anyone who is appointed to a top executive position this year.

By using such data from 1992 to 2002, we have provided fresh evidence on the effects of the nature and scope of human capital on career success (measured by appointments to top executive positions). First, we have found that broadening the scope of human capital by experiencing various roles (becoming a generalist) is advantageous for career success, controlling for education, gender, current occupation, age, general work experience, and tenure.

¹⁵ Murakami (2009) presents a somewhat similar idea on why the breadth of human capital is beneficial for R&D directors.

In this respect our finding has lent external validity to a recent case study (Lazear, 2010) which reports a similar finding for a relatively small and selective sample of Stanford MBAs.

Second, we have confirmed the beneficial effect of acquiring general human capital formally through schooling for subsequent career success, as well as the gender gap in career success rates (female workers are less likely to be appointed to top executive positions, after controlling for a variety of personal characteristics).

Third, we have obtained evidence for complementarity between initial human capital obtained through formal schooling and subsequent human capital obtained informally on the job. Though a number of theorists predicted such synergic interplay between schooling and on-the-job training, we believe our study is the first to provide rigorous evidence on such interplay in the context of top executive appointments.

Fourth, though there is a large body of literature on the relationship between firm-specific human capital and wages, the relative value of firm-specific human capital has been rarely studied in the context of appointments to top executive positions. We have found the first evidence that it is more beneficial to broaden the breadth of human capital within the firm than without, pointing to the significance of firm-specific human capital for career success.

Finally, the breadth of human capital obtained on the job has been found to be more beneficial for R&D directorship than for other functional area directorships, pointing to possible heterogeneity of the value of the breadth of human capital among different functional areas.

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Table 1. Changes in DISCO Codes Between 1992 and 2002

	# of Codes	# of New Codes Added	# of Discontinued Codes
All			
1-digit DISCO code	9	0	0
2-digit DISCO code	34	1	0
3-digit DISCO code	144	14	2
4-digit DISCO code	494	81	14
DISCO Code with Cell Size > 100			
1-digit DISCO code	9	0	0
2-digit DISCO code	33	1	0
3-digit DISCO code	100	2	0
4-digit DISCO code	232	8	2
DISCO Code with Cell Size > 1000			
1-digit DISCO code	9	0	0
2-digit DISCO code	28	0	0
3-digit DISCO code	65	0	0
4-digit DISCO code	97	3	0

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Table 2. Descriptive Statistics

	Eight Years of Complete Employment History				No Restrictions on the Employment History
	Appointed to top executive position in firms with 100 or more employees	Contestant pool excluding those appointed to top executive positions	Contestant pool	All private sector employees	All private sector employees
<i>ROLES (pct):</i>					
0	5.56	15.32	15.27	15.04	
1	20.98	30.22	30.17	30.15	
2	27.43	24.55	24.56	24.67	
3	21.09	15.87	15.90	15.99	
4	14.35	8.36	8.39	8.43	
5	7.13	3.78	3.80	3.81	
6	2.41	1.39	1.40	1.40	
7	0.89	0.43	0.43	0.43	
8	0.16	0.08	0.08	0.08	
<i>Education (pct):</i>					
LESS-THAN-HIGH- SCHOOL	12.54	24.28	24.22	23.90	32.49
HIGH-SCHOOL	45.16	60.03	59.96	59.49	51.63
VOCATIONAL	5.59	5.01	5.01	5.03	4.68
COLLEGE	24.81	7.44	7.52	8.00	7.10
GRADUATE	11.91	3.24	3.29	3.57	4.11
FEMALE	0.13	0.28	0.28	0.27	0.36
AGE	44.45 (8.42)	45.90 (9.00)	45.90 (8.99)	45.94 (8.99)	37.29 (12.68)
TENURE	6.72 (6.95)	8.22 (7.56)	8.21 (7.56)	8.23 (7.58)	4.73 (5.63)
EXPERIENCE	22.45 (7.85)	23.49 (7.90)	23.48 (7.89)	23.52 (7.91)	14.42 (10.85)
# Observations	3,813	769,281	773,094	799,854	2,913,253

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Table 3. Logit Estimates of the Effects on Career Success of Formal and Informal Human Capital

	Logit		
	(i)	(ii)	(iii)
ROLES	0.212*** (0.013)		0.184*** (0.029)
ROLES1		0.531*** (0.082)	
ROLES2		1.003*** (0.086)	
ROLES3		1.167*** (0.092)	
ROLES4		1.379*** (0.097)	
ROLES5		1.440*** (0.108)	
ROLES6		1.360*** (0.139)	
ROLES7		1.608*** (0.199)	
ROLES8		1.735*** (0.434)	
HIGH-SCHOOL	0.193*** (0.055)	0.196*** (0.055)	0.127 (0.094)
VOCATIONAL	0.221*** (0.088)	0.229*** (0.087)	0.253* (0.151)
COLLEGE	1.032*** (0.064)	1.050*** (0.064)	0.989*** (0.108)
GRADUATE	1.219*** (0.080)	1.235*** (0.080)	0.986*** (0.130)
FEMALE	-0.711*** (0.056)	-0.714*** (0.055)	-0.715*** (0.056)
ROLES *HIGH-SCHOOL			0.027 (0.031)
ROLES *VOCATIONAL			-0.009 (0.047)
ROLES *COLLEGE			0.016 (0.034)
ROLES *GRADUATE			0.090** (0.039)
Pseudo R-square	0.123	0.125	0.123
Observations	773,094	773,094	773,094

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.

Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 4. Logit Estimates of the Effects on Career Success of Formal and Informal Human Capital: Gender Differences

	Logit					
	(i)		(ii)		(iii)	
	Men	Women	Men	Women	Men	Women
ROLES	0.210*** (0.013)	0.194*** (0.038)			0.157*** (0.031)	0.327*** (0.081)
ROLES1			0.522*** (0.089)	0.547** (0.215)		
ROLES2			1.001*** (0.093)	0.933*** (0.229)		
ROLES3			1.150*** (0.099)	1.168*** (0.245)		
ROLES4			1.393*** (0.105)	1.118*** (0.268)		
ROLES5			1.442*** (0.116)	1.238*** (0.302)		
ROLES6			1.359*** (0.148)	1.168*** (0.420)		
ROLES7			1.467*** (0.220)	2.307*** (0.466)		
ROLES8			1.816*** (0.437)	--		
HIGH-SCHOOL	0.185*** (0.060)	0.110 (0.149)	0.188*** (0.060)	0.113 (0.149)	0.034 (0.102)	0.531** (0.254)
VOCATIONAL	0.199** (0.096)	0.304 (0.216)	0.205** (0.096)	0.328 (0.216)	0.203 (0.166)	0.519 (0.374)
COLLEGE	0.996*** (0.068)	0.999*** (0.194)	1.012*** (0.068)	1.034*** (0.193)	0.875*** (0.115)	1.478*** (0.321)
GRADUATE	1.115*** (0.086)	1.652*** (0.223)	1.130*** (0.086)	1.684*** (0.223)	0.842*** (0.138)	1.608*** (0.387)
ROLES * HIGH-SCHOOL					0.060* (0.033)	-0.190** (0.086)
ROLES * VOCATIONAL					0.003 (0.051)	-0.100 (0.122)
ROLES * COLLEGE					0.047 (0.036)	-0.207** (0.103)
ROLES * GRADUATE					0.106** (0.042)	-0.012 (0.112)
Pseudo R-square	0.116	0.124	0.118	0.126	0.116	0.125
Observations	559,643	206,397	559,643	206,326	559,643	206,397

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.

Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 5. Logit Estimates of the Effects on Career Success of the Internally Broadened Scope of Human Capital

	Logit	
	(i)	(ii)
ROLES	0.212*** (0.013)	0.169*** (0.014)
INT_ ROLES		0.249*** (0.026)
Pseudo R-squared	0.123	0.125
Observations	773,094	773,094

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.

Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 6. Multinomial Logit Estimates of the Effects on Career Success of the Internally Broadened Scope of Human Capital

Reference Destination: Not winning a top management appointment	Internal Promotion	External Recruitment
ROLES	0.140*** (0.017)	0.195*** (0.023)
INT_ ROLES	0.347*** (0.031)	0.077* (0.046)
HIGH-SCHOOL	0.219*** (0.065)	0.148 (0.097)
VOCATIONAL	0.308*** (0.103)	0.062 (0.153)
COLLEGE	1.140*** (0.077)	0.893*** (0.110)
GRADUATE	1.351*** (0.095)	1.033*** (0.131)
FEMALE	-0.727*** (0.066)	-0.666*** (0.088)

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.

Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 7. Logit Estimates of the Effects of the Breadth of Human Capital on Directorship Appointments in One of Four Functional Areas

	Logit							
	(i)				(ii)			
	Finance	HR	R&D	Sales and Marketing	Finance	HR	R&D	Sales and Marketing
ROLES	0.196*** (0.043)	0.220*** (0.080)	0.413*** (0.078)	0.145** (0.058)	0.167*** (0.045)	0.181** (0.088)	0.343*** (0.085)	0.107* (0.062)
INT_ROLES					0.189** (0.086)	0.225 (0.174)	0.412** (0.165)	0.223** (0.100)
Pseudo R-squared	0.128	0.077	0.141	0.083	0.129	0.078	0.145	0.084
Observations	398,549	415,830	332,810	461,065	398,549	415,830	332,810	461,065

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.

Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Figure 1. Top Executive Appointments and the Size of the Contestant Pool by (one-digit) Occupations

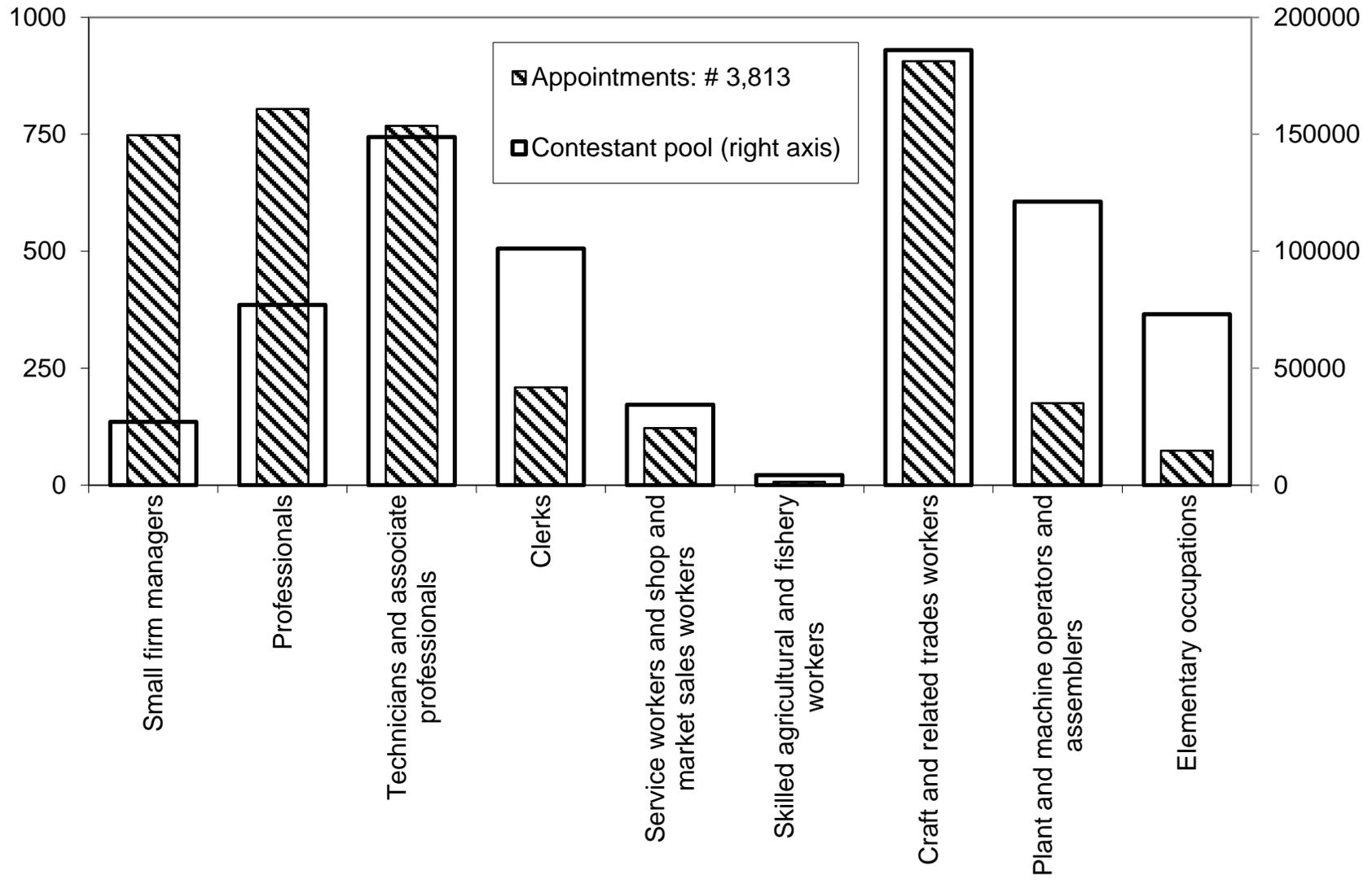


Figure 2. Career Success and Formal Schooling: Gender Differences

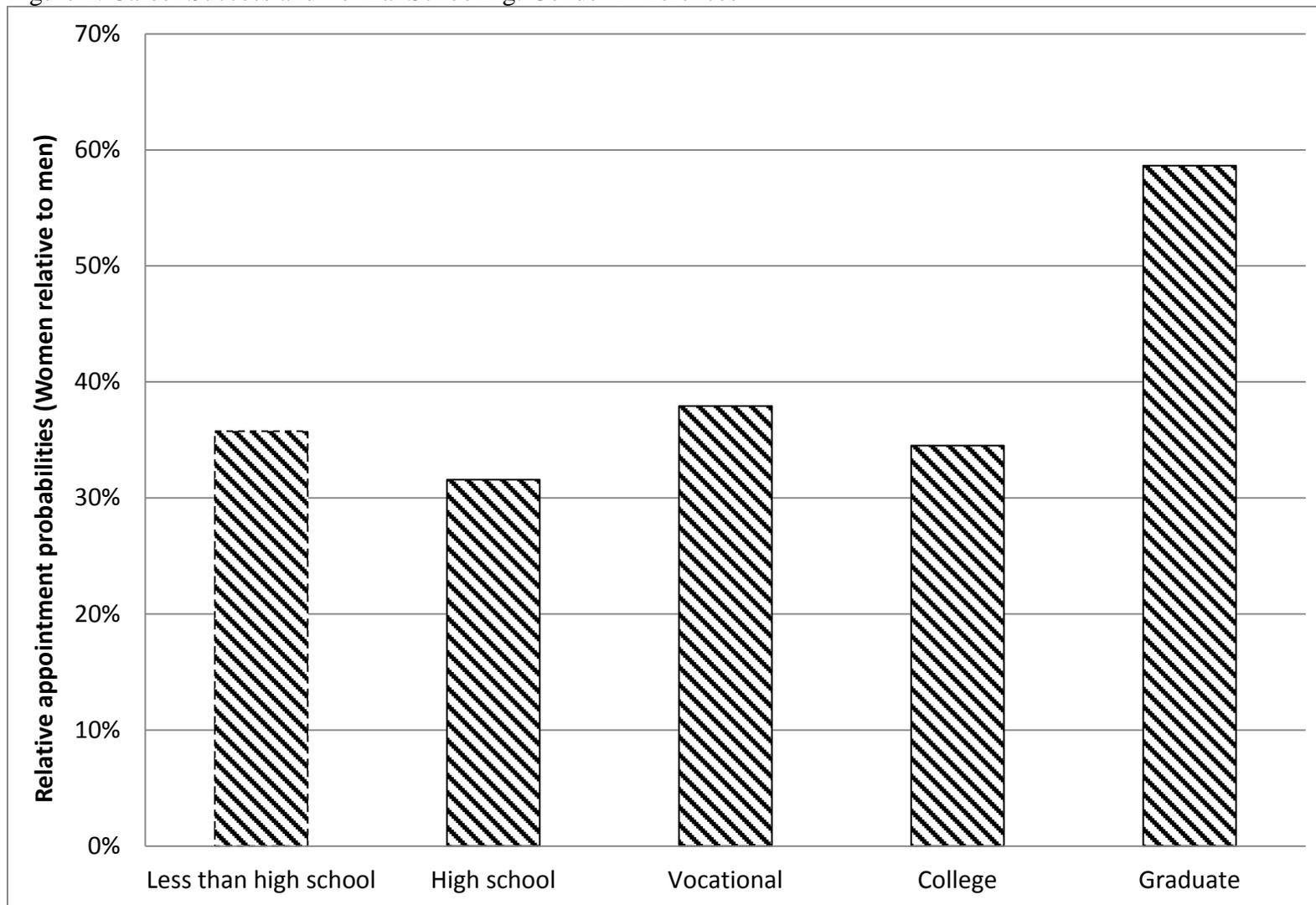


Figure 3. Role-Career Success Profiles for Workers with Different Levels of Educational Attainment

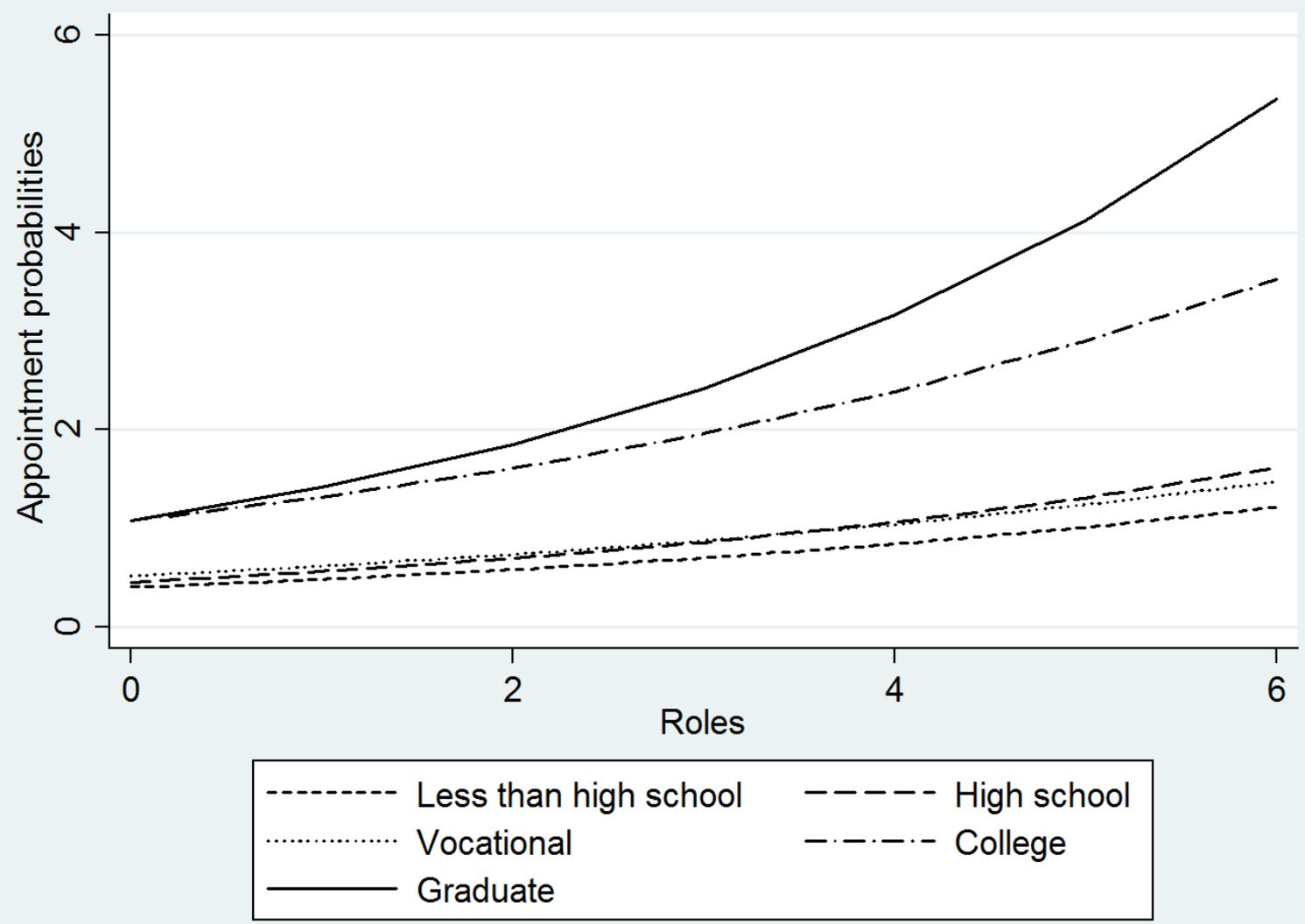
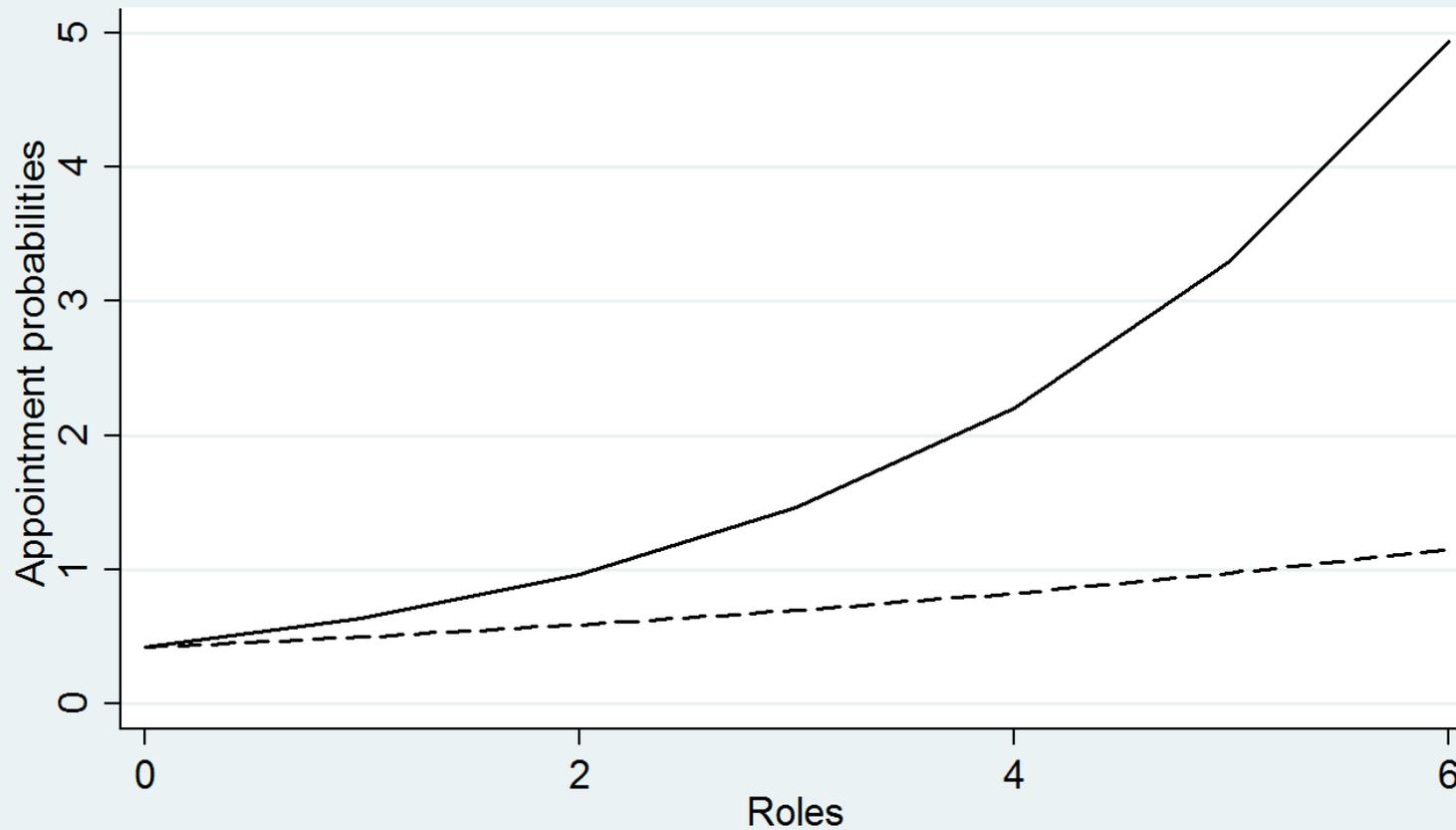


Figure 4. Role-Career Success Profiles for College Graduates: Internal Career vs. External Career



Internal career: All roles experienced with present employer

External career: Only current role is with present employer

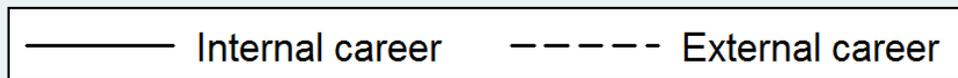


Figure 5. Role-Career Success Profiles for College Graduates: External Recruitment vs. Internal Promotion

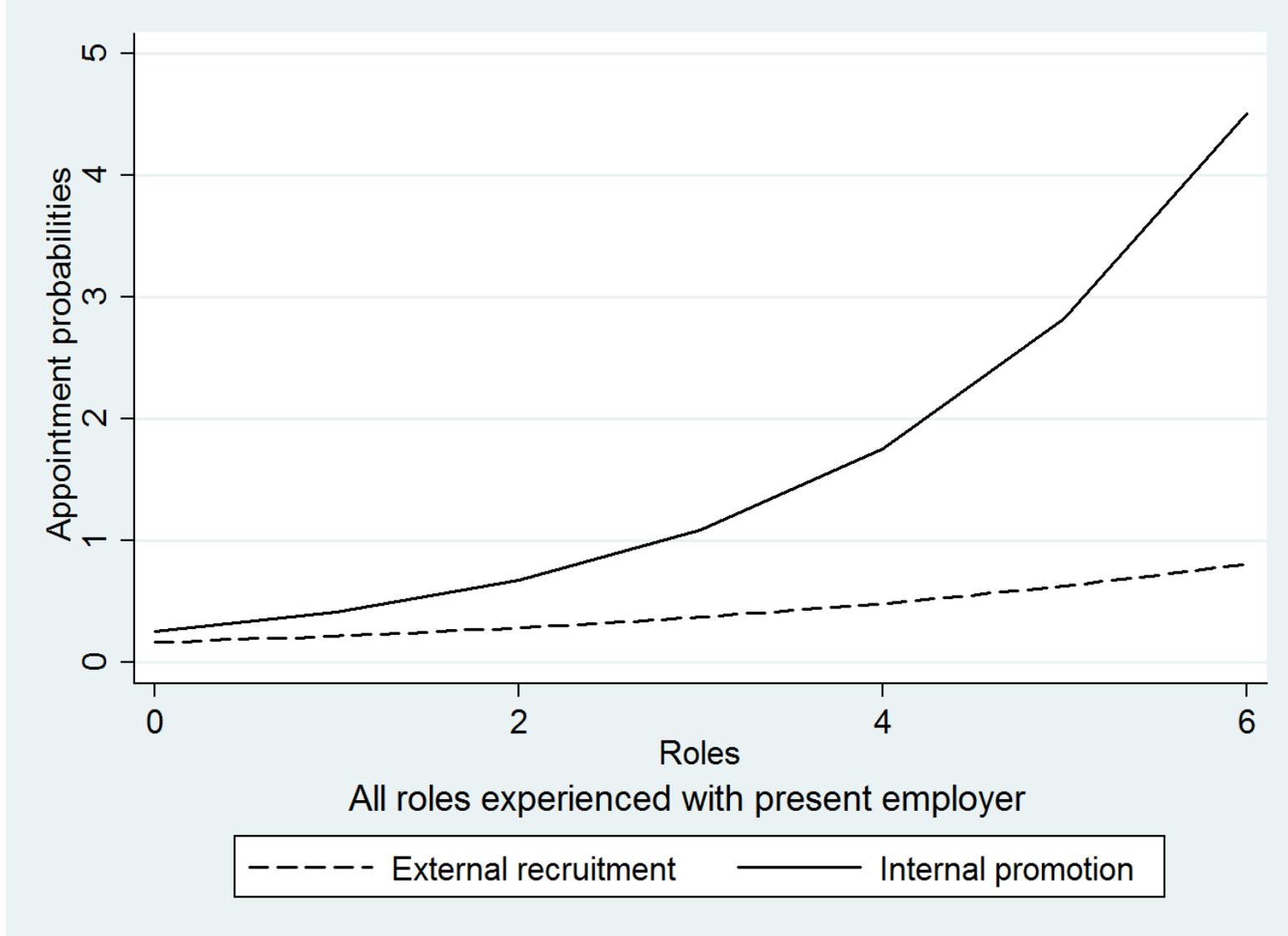


Figure 6. Role-Career Success Profiles for College Graduates: Different Directorships

